



POPULAR SCIENCE

MONTHLY

Three magazines in one
AUTOMOBILES • HOME & SHOP • MECHANICS

15¢

20¢ IN CANADA

OCT.

NEW TOOLS FOR ARMY STRENGTH
PAGE 73

How Warplanes
Fight At Night
PAGE 82

**THIS COMPLETE, SIMPLE, PRACTICAL COURSE
FOR SELF-INSTRUCTION WILL QUICKLY GIVE YOU**

a complete mastery of
Mathematics



**An Expert Gives You His
Simplified Methods**

Mr. Thompson, the author of these books, is not an ordinary teacher of mathematics. He has had many years experience in giving students the kind of mathematical training they need in practical work. He presents each practical method and problem in the clearest and simplest way. He gets right down to the kind of information that you need in your daily work.

Don't let appearances fool you, mathematics is easy. You can get these books on approval and see for yourself how much enjoyment you will have while getting this valuable training and solving interesting practical problems that puzzle your friends and fellow workers. In no time at all you will be tackling with ease the most difficult question on this subject.

PREPARE now for an important job in America's booming defense industries—learn mathematics. Mathematics is the basic requirement of all mechanical and scientific work, and of all business or industry based on science. Without this essential knowledge even the most capable man is left behind while others forge ahead to better jobs, bigger contracts, more money. You need mathematics to understand all technical work, to supervise operations, to improve, speed up and check on your work and the work of others. Such basic training is quickly recognized today and gladly paid for. It singles you out from the crowd and gives you an advantage whether it is a matter of a job, a promotion or a contract.

Now you can learn mathematics by an easy inexpensive and time-saving method. This very simple and extremely interesting course in book form has been prepared for you by an expert who has devoted a lifetime to teaching practical men the fundamentals of this important subject.

**A Complete Course and Reference Library in
These Five Volumes • 1,598 Pages • Illustrated**

MATHEMATICS FOR SELF STUDY starts right from the beginning with a review of arithmetic that gives you all special short cuts and trick problems that save countless hours of your time and make you more valuable to yourself and your job. Then these books go right into higher mathematics and show how simple it is when an expert explains it for you.

ARITHMETIC: Starting with a quick review of principles, this volume presents all the special calculation methods used in business and industry which every practical man should know. Fundamental in all computations in engineering, both military and civilian. Essential methods for rapid calculation such as is needed in firing guns, setting lathes, etc. Systems of measurement and their computation required in machine work. Hundreds of other applications to technical work.

ALGEBRA: Starting with simple practical problems, this book shows you, step by step, how to apply algebraic methods to the most complex problems. Shows how to
(Continued on next page)

MATHEMATICS IS THE INDISPENSABLE FOUNDATION KNOWLEDGE FOR TODAY'S NEW *technical & mechanical* Defense Jobs



THOUSANDS of new jobs are calling for trained men! Every industry is rapidly expanding to meet the needs of our gigantic defense program. Trained mechanics and technicians are in urgent demand. In many lines there are more jobs than men prepared to fill them.

And in the best of these jobs, the jobs which offer the highest pay and the greatest assurance of steady employment, a knowledge of mathematics is required, because mathematics is the foundation of all technical work. Give yourself this basic preparation now by this quick, inexpensive home-study method—a complete mathematics course in five volumes.

MATHEMATICS for Self Study

by J. E. Thompson, B.S. in E.E., A.M., Dept. of Mathematics, Pratt Institute

(Continued from facing cover)

solve problems which are involved in all military and industrial work, relating to machines, engines, projectiles, ships, planes, etc. Logarithms and slide rule, and many other practical applications.

GEOMETRY: States clearly all needed facts about plane figures, circles, polygons, etc. Covers all the topics essential in drafting and engineering. It deals at length with angles, triangles, circles, and the many other geometric figures that are basic to engineering design. Sheet metal work, so important in airplane construction, is a direct application of these principles. So also is the laying out of ship hulls, which is the major activity in ship construction. The properties of circles and spheres explained in this volume also apply directly in navigation.

TRIGONOMETRY: This volume makes easy the principles of angles and triangles, shows you how to use tables that explain their functions. Practically every problem in machine work, land surveying, mechanics, astronomy, navigation and range finding is solved by methods of trigonometry. These methods are explained here in the most simple way with actual examples of calculations of height and distance as they are applied directly to the sighting of guns and the determination of the position of a ship at sea, the construction of buildings and fortifications, the cutting of gears, etc., etc. All necessary tables for making these computations are furnished in this book as they are in all the other volumes of this series.

Examine These Books FREE

Send no money now. The coupon brings you the 5 books for 10 days' trial. After 10 days return the books to us without obligation or send us the small down payment of \$2.95, balance in three monthly payments (5% discount for cash). D. VAN NOSTRAND COMPANY, Publishers, 250 Fourth Avenue, New York, N. Y.

CALCULUS: You will enjoy mastering calculus in this interesting new way and will find it will enable you to solve problems that can be solved in no other way. This branch of mathematics deals with rate problems. It is essential in computation involving objects moving with varying rates of speed. It also enables us to find the most efficient design for any kind of mechanism, engine, or moving vehicle. Typical problems included in this book are the calculation of the velocity with which a man supported by a parachute strikes the ground, the path of a bullet or shell, the work done by expanding gas or steam (which is applied directly in the design of rifles and cannon).

These are but a few of the hundreds of subjects simplified and explained in this complete reading course in mathematics.

Free Examination Coupon

D. Van Nostrand Co., 250 Fourth Ave.,
New York, N. Y.

Send me MATHEMATICS FOR SELF STUDY in 5 volumes. Within 10 days I will either return the books or send you \$2.95 as first payment and \$2.00 per month for three months—total \$8.95. (5% discount for cash).

P.S.M.-10-41

Name.....

Address.....

City and State.....

Reference.....

Address.....

POPULAR SCIENCE

FOUNDED 1872

MONTHLY

VOL. 139 NO. 4

Mechanics & Handicraft

THE NEWS PICTURE MAGAZINE OF SCIENCE AND INDUSTRY

CONTENTS *for* OCTOBER, 1941

News

Flags for Our Navy.....	40
Leaping Lena Joins the Army.....	52
Rubber Paint	59
New Tools for Army Power.....	73
How Warplanes Fight at Night.....	82
"Nerve Center" Guards New York.....	89
Priorities Hit Your Home.....	93
Stay Hungry and Live Longer.....	97
Fighting the Submarine Mine.....	102
Museums for Sale.....	109
Natural Cement Comes Back.....	118

Automobiles

Trade Schools for Defense.....	123
Timesavers for Car Owners.....	130
Know Your Car's Ignition System.....	132
Gus Wilson's Model Garage.....	134

Home and Workshop

House-Planning Contest Awards.....	138
One-Floor House Wins First Prize.....	149
Modern Jointers Speed Up Planing....	158
Sewing Cabinet in Swedish Modern....	162
Storing Your Boat for the Winter.....	184
How to Save Storm-Damaged Trees....	186
Machinists for Defense.....	188
Twin-Carbon Arc Welding Torch.....	194
Getting a Photographic Education.....	207

Departments

Our Readers Say—.....	14
Book Reviews	72
Question Bee	72
Here's My Story.....	112
Un-Natural History	117
Radio Department	202
With the Inventors.....	230



YATES STIRLING, Jr., Rear Admiral, U. S. N., Retired ("Fighting the Submarine Mine," page 102) has commanded every type of war vessel in his 45 years of active service in the U. S. Navy. He swept mines in the Spanish-American War; handled a gunboat in the Philippine Insurrection; ferried troops to Europe in World War I; commanded the famous Yangtze Gunboat Patrol in China.

EDITOR Charles McLendon
MANAGING EDITOR . George H. Waltz, Jr.
HOME & WORKSHOP EDITOR Arthur Wakeling
ASSOCIATES: Carsten Grande, *Art Editor*;
Fred O. Newman, *News*; William Morris,
Photography; Schuyler Van Duyne, *Automobiles*;
Alden P. Armagnac, Edwin Teale,
David M. Stearns, Harry Walton, *Group Editors*;
B. T. Richards, *Copy Editor*; Michele
de Santis, Harry Samuels, Stewart Rouse,
Michael Cerniello, *Art Assistants*.

Published monthly at 353 Fourth Avenue, New York, N. Y., by Popular Science Publishing Co., Inc. Godfrey Hammond, President and Treasurer; R. C. Wilson, Raymond J. Brown, Vice Presidents; F. W. Briggs, Secretary. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U.S.A. Copyright, 1941, by Popular Science Publishing Co., Inc. All rights reserved in the United States, Great Britain, and in all countries participating in the International Copyright Convention and the Pan American Copyright Convention. Single copy, 15 cents; Canada, 20 cents. Yearly subscriptions to United States and its possessions, \$1.50; Canada, \$2.00; foreign countries, excepting Canada, \$2.50. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address.

LEARN SHORTHAND *in* 6 WEEKS

..at home.. for only 8¼ cents a lesson!

Speedwriting
TRADE MARK, REG. U.S. PAT. OFF.

THE SHORTHAND FOR EVERYONE!
Easiest to LEARN! Easiest to WRITE!

THIS is the same famous SPEEDWRITING system of Shorthand for which thousands gladly paid \$9.95. It is the **EASIEST SHORTHAND TO LEARN** because you use the alphabet you already know instead of strange signs and symbols.

Now, for the first time, you can have this same complete six-volume course of sixty lessons—but with a practical Self-Teaching Manual **ADDED** so you can learn **RIGHT AT HOME**—for only \$4.95, if you act promptly! This is the same Speedwriting system of Shorthand that is used in scores of business schools and public school commercial departments. Never before have these six volumes been sold for less than \$9.95. Our special offer saves you 50%. And, in addition, you get the Self-Teaching Manual that enables you to become a fast, accurate shorthand writer in only 72 hours of home study.

WIN a Good Job—Promotion—Higher Pay!

You can't believe how **EASY** Speedwriting is, how **VALUABLE** it is, until you see it. If you want the **EASIEST**, most **SENSIBLE** of all **RECOGNIZED** systems of Shorthand at this amazingly low price, (with the beautiful **DESKMASTER** **FREE**) seize this opportunity while it lasts. Just mail coupon. Pay the postman only \$4.95, plus a few cents postage, when he delivers the course and **DESKMASTER**. If you decide to return them within 5 days, your money will be promptly refunded.

CONSULTATION SERVICE FREE if you act promptly

As a special inducement to get your coupon in the mail at once, we offer the privilege of **CONSULTATION** by mail with the staff experts of Speedwriting, Inc., on any point, if you keep the Speedwriting Course. This is a service that even subscribers at the former \$9.95 price did not get and it makes the present \$4.95 offer a still more sensational bargain. But you must act at once to get this **FREE CONSULTATION SERVICE**.

SPEEDWRITING, Inc., Dept. 240, 200 Madison Ave., New York, N.Y.

SEND NO MONEY Unless You Wish To!

FREE

As Your
Reward for
Promptness

**This Beautiful
DESKMASTER**



The latest, smartest executive's desk set—made of heavy, rich, wood-textured bakelite. Includes handsome, lever-filler fountain pen and propelling pencil to match. Provided with reservoir for extra ink, additional pen and pencil rests, and ample wells for clips and rubber bands! Sent to you **FREE** with the Speedwriting Course! Mail coupon now!

THOUSANDS GLADLY PAID \$9.95 FOR IT

NOW

only \$4.95

IF YOU ACT NOW

PLUS A FEW CENTS FOR POSTAGE AND PACKAGING

Self Teaching Manual

**6 Volumes
60 Lessons
Plus
Self-Teaching Manual**

FLASH!

**U.S. Navy Men Now
Get Training in
Speedwriting!**

In answer to America's emergency call for all possible speed in defense work, Speedwriting is being taught to classes for navy stenographers at Orlando, Florida. This quickest and easiest system to learn and write prepares efficient, capable shorthand writers in only 72 hours of study—often less!

Defense industries must have thousands of stenographers at once! Be ready for a job in WEEKS instead of MONTHS!

Mail This Big Bargain Coupon NOW!

**SPEEDWRITING, INC., Dept. 240
200 Madison Ave., New York, N. Y.**

Send me without obligation the 6-Volume Home Study Course in **SPEEDWRITING** Shorthand that formerly sold for \$9.95, including also the Self-Teaching Manual, and the **DESKMASTER** set as a **FREE** gift. I will pay the postman the **REDUCED PRICE** of only \$4.95 (plus a few cents postage.) In consideration for **PROMPT MAILING** of this coupon I am to have the privilege of **FREE CONSULTATION** by mail with the Staff of Speedwriting, Inc., during my study of the Course. If I return the course and Deskmaster within 5 days, my money will be refunded in full.

Name.....

Address.....

City..... State.....

☐ If you care to send full payment now (\$4.95), we will pay the postage. Same refund privilege.



Why guess
— WHEN EXPERTS SPECIFY
AUTO-LITE BATTERIES !
Here's How To Get Dependability,
Power, Longer Battery Life



FOLLOW the lead that's set by America's top-ranking engineers. Today, 1 out of every 3 car makers uses Auto-Lite Batteries as standard equipment. What's more, these famous batteries are used on giant flying clippers spanning the Atlantic and Pacific Oceans where dependable power counts most. Experts have found Auto-Lite's longer life and trouble-free service save plenty. You can have these advantages too...because now Auto-Lite Batteries are priced with the lowest. Stop at your Auto-Lite Battery Dealer's now. He will check your present battery free! See him today.

USL BATTERY CORPORATION
 A Subsidiary of
 The Electric Auto-Lite Company
 NIAGARA FALLS, NEW YORK

AUTO-LITE
BATTERIES
ENGINEERED AS A
 BALANCED UNIT OF THE
 ELECTRICAL SYSTEM

Contents [CONTINUED]

Automobiles

Lamp Bakes Paint on Autos.....	81
"Sound" Trucks Use Lights.....	101
System Runs Car on Oil Fuel.....	114
Roller Coaster Speeds Assembly....	129
Flour Marks Safe-Driving Course...	129
Eliminating Car Static.....	130
A Car-Washing Aid.....	130
Dashboard Shelf of Many Uses.....	130
Handy Way to Apply Jack.....	130
Homemade Fire Extinguisher.....	131
Testing Tire Pressure Quickly.....	131
Antenna from Coat-Hanger Wire....	131
Safety Lock for Car Door.....	131

Facts and Ideas

Bank Gives Curb Service.....	63
Flying-School Pranks	64
Sleep Booth for Night Worker.....	68
Matching Chips Tests Color Vision..	70
Cabinetmaker Builds Guitars.....	78
Stars Use Make-Up Chair.....	79
Test-Tube Garden Starts Orchids...	81
Floodlights for Emergency Fields...	92
Radio Clocks Rifle Bullets.....	101
Police Plan "Fingerprints" Faces....	115
Explosives from Corncocks.....	116
Models Microscopic Life.....	121

Inventions

Chemical Smothers Fire Bombs.....	66
File Has Slots to Pass Chips.....	78
Dry Cell Stays Fresh.....	78
Sun-Lamp Bulb for Homes.....	79
Operating Room Has Armor.....	80
Plastic Paint Keeps Dials Clean....	80
Safety-Razor Magnet Lifts Blade....	81
New Light-Polarizing Material.....	92
New Tools	100
Portable Blood-Transfusion Kit.....	114

Craftwork

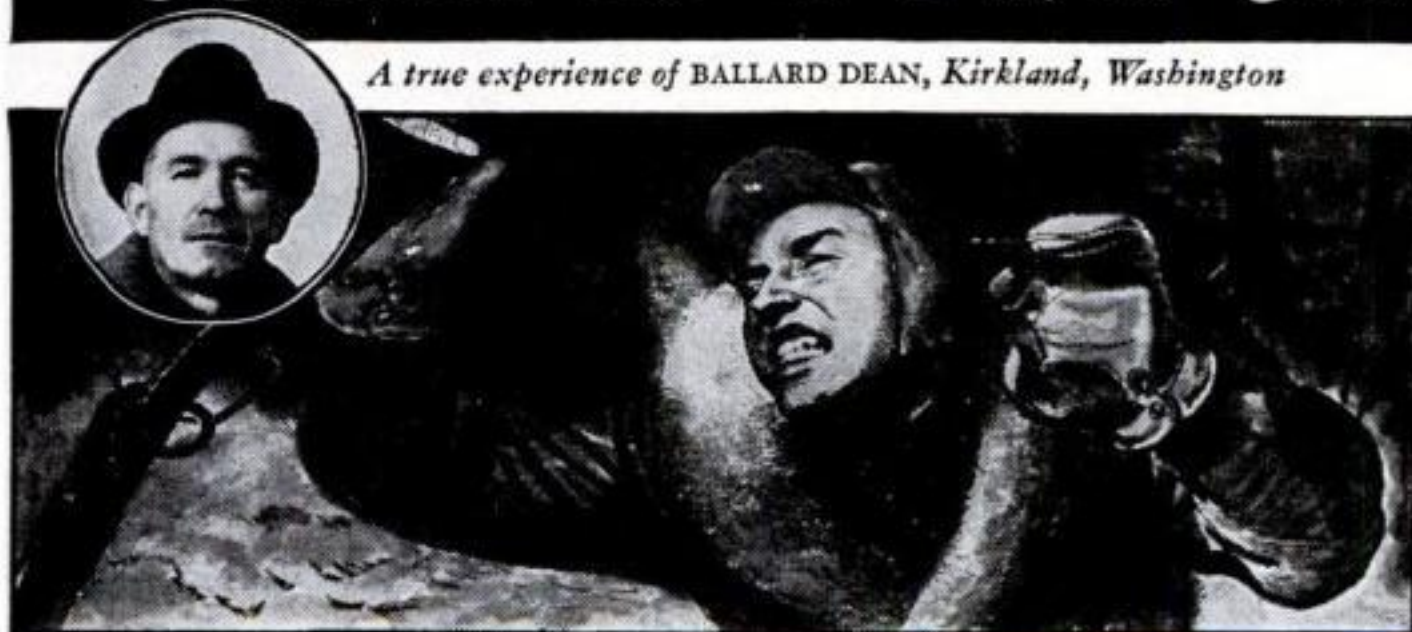
Leather Craft Is Useful Hobby.....	168
Art Metal Cast in Home Foundry....	170

(Continued on page 6)

IMPORTANT NOTICE: The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, Popular Science Monthly does not underwrite the business methods of the individuals or concerns producing them. To avoid liability for patent infringement, readers should investigate before making, using, or offering for sale any of the devices, machines, or processes described; Popular Science Monthly takes no responsibility. The use of Popular Science Monthly articles for stock-selling schemes is never authorized.

"THE JAWS OF DEATH CLAMPED DOWN ON ME!"

A true experience of BALLARD DEAN, Kirkland, Washington



"THE THING sprang out of the earth one bitterly cold evening as I was returning to camp after an all-day deer hunt," writes Mr. Dean. "I suffered excruciating agony, as it bit into my leg. It was a bear trap, illegally set for deer."

"FRANTICALLY, I TRIED TO GET LOOSE as the cold knifed through my clothing. With sinking heart, I found my struggles of no avail. In a few hours, if help could not be summoned, I would freeze to death. Darkness came on as I fought hopelessly with the strong steel jaws."



"THEN I THOUGHT OF MY FLASHLIGHT. There was a chance that other returning hunters might be in the woods. Flashing the bright beam off and on, my efforts were finally rewarded. Thanks to those 'Eveready' fresh DATED batteries, two men saw my signal and rescued me from that death trap."

(Signed) Ballard Dean

The word "Eveready" is a registered trade-mark of National Carbon Company, Inc.

FRESH BATTERIES LAST LONGER... Look for the DATE-LINE

NATIONAL CARBON COMPANY, INC., 30 EAST 42nd STREET, NEW YORK, N. Y.

Unit of Union Carbide and Carbon Corporation





For best performance with greatest economy
be sure your spark plugs are
CHAMPIONS!

The broad smooth ribbons of concrete which criss-cross America and the latest super-highways are an invitation to swift travel by motor car. But they are also a severe and sometimes costly test of its condition.

Sustained high speeds cause gas and oil consumption to go up by leaps and bounds. High operating temperatures oftentimes cause pre-ignition—that sudden, annoying loss of power with rough, uneven engine operation which shows that your spark plugs either haven't the proper heat range or have been thrown out of it by compression leakage through the spark plugs.

Champion's patented Sillment seal eliminates troublesome leakage common to ordinary spark plugs and holds each spark plug rigidly within its assigned heat range, thus giving Champions the widest possible operating range. Insist on Champions for best performance, with greatest economy.

You're always ahead with Champion!
SPARK PLUGS

Contents [CONTINUED]

A Lazy-Susan Condiment Set.....	174
Rack for Table-Tennis Balls.....	175
Two Cigarette or Jewel Boxes.....	175
Novel Clock for the Rumpus Room..	176
Turned and Inlaid Powder Bowl....	177
Child's Jig-Sawed Menagerie.....	178
Danny Drake Holds Place Cards.....	180
Dowel-and-Plastic Flowerpot Rack..	180
Sharp's Rifle Whittled in Wood.....	181
Control Box for Model Railway.....	182
Detail on Scale-Model Planes.....	183

Home Building

House-Planning Contest Awards.....	138
How Prize Winners Were Selected..	139
An Analysis of Contest Entries.....	142
Best Plan Reworked Fifteen Times..	146
One-Floor House Wins First Prize..	148
Ideas for the Home Owner.....	154


Miscellaneous

Keeping the Home Shipshape.....	156
Fluorescent Tubes in Floor Lamp...	166
Jigger Pitchers for Iced Drinks.....	166
Timer for Automatic Defrosting....	166
Non-Tarnish Coating for Silver.....	166
Soup Herbs Grow in the Kitchen....	166
Two-Way Sponge Is Ironing Aid....	167
Paper Strainers for Kitchen Use....	167
Slip-On Ironing-Board Cover.....	167
Pliable Metal Rod for Drapes.....	167
Magic of Cold from Chemistry.....	197
Tests Show Odd Facts about World..	200

New Shop Ideas

Machinists for Defense.....	188
Turning an Accurate Plumb Bob....	188

(Continued on page 8)



Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug
 Champion has designed 3 spark plugs for model gas engines which give the same dependable performance as regular Champions. Sillment sealed. Sillimanite insulator. Alloy needlepoint

electrodes for easy starting. One piece construction.

CHAMPION
 SPARK PLUG CO.
 901 Upton Ave.
 Toledo • Ohio



These are weapons in America's defense!

★ Today, the lathe, the drafting board and the drill press are defense weapons as much as planes, tanks and guns. For in America's capacity to *produce* lies the security of this western hemisphere!

Whether you work at a desk, a machine or a plow, MODERN TRAINING can make you a more important cog in the machinery of America's defense program. Without it, you may even be a hindrance! Get the training you need — for your own security and your country's — through the Schools which have prepared thousands of ambitious men for leadership in business and industry — the *International Correspondence Schools!*

Study in your spare time, at low cost, with no classroom slow-pokes to hold you back! For complete information without obligation, *mail the coupon immediately.*

INTERNATIONAL CORRESPONDENCE SCHOOLS

CELEBRATE 50 YEARS OF SERVICE TO AMBITIOUS AMERICANS

1891 ★ 1941

BOX 7618-K, SCRANTON, PENNA.

★ Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course *before* which I have marked X: ★

TECHNICAL AND INDUSTRIAL COURSES

- | | | | | | |
|---|---|---|---|--|--|
| <input type="checkbox"/> Agriculture | <input type="checkbox"/> Air Brake | <input type="checkbox"/> Contracting and Building | <input type="checkbox"/> Marine Engines | <input type="checkbox"/> R. R. Signalman | <input type="checkbox"/> Refrigeration |
| <input type="checkbox"/> Air Conditioning | <input type="checkbox"/> Cotton Manufacturing | <input type="checkbox"/> Diesel Engines | <input type="checkbox"/> Mechanical Drafting | <input type="checkbox"/> Sanitary Engineering | |
| <input type="checkbox"/> Airplane Drafting | <input type="checkbox"/> Electrical Drafting | <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Sheet Metal Work | |
| <input type="checkbox"/> Architectural Drafting | <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Foundry Work | <input type="checkbox"/> Mine Foreman | <input type="checkbox"/> Ship Drafting | <input type="checkbox"/> Shop Practice |
| <input type="checkbox"/> Architecture | <input type="checkbox"/> Heating | <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Navigation | <input type="checkbox"/> Steam Electric | <input type="checkbox"/> Steam Engines |
| <input type="checkbox"/> Auto Engine Tune-up | <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> House Planning | <input type="checkbox"/> Patternmaking | <input type="checkbox"/> Steam Fitting | |
| <input type="checkbox"/> Auto Technician | <input type="checkbox"/> Locomotive Engineer | <input type="checkbox"/> Machinist | <input type="checkbox"/> Pharmacy | <input type="checkbox"/> Structural Drafting | |
| <input type="checkbox"/> Aviation | <input type="checkbox"/> Management of Inventions | <input type="checkbox"/> Mfg. of Pulp and Paper | <input type="checkbox"/> Plumbing | <input type="checkbox"/> Structural Engineering | |
| <input type="checkbox"/> Aviation Mechanic | | | <input type="checkbox"/> Poultry Farming | <input type="checkbox"/> Surveying and Mapping | |
| <input type="checkbox"/> Boilermaking | | | <input type="checkbox"/> Practical Telephony | <input type="checkbox"/> Telegraph Engineering | |
| <input type="checkbox"/> Bridge Engineering | | | <input type="checkbox"/> Public Works Engineering | <input type="checkbox"/> Telephone Work | |
| <input type="checkbox"/> Chemistry | | | <input type="checkbox"/> Radio, General | <input type="checkbox"/> Textile Designing | <input type="checkbox"/> Toolmaking |
| <input type="checkbox"/> Civil Engineering | | | <input type="checkbox"/> Radio Operating | <input type="checkbox"/> Welding, Electric and Gas | |
| <input type="checkbox"/> Coal Mining | | | <input type="checkbox"/> Radio Servicing | <input type="checkbox"/> Woolen Manufacturing | |
| <input type="checkbox"/> Concrete Engineering | | | <input type="checkbox"/> R. R. Section Foreman | | |

BUSINESS COURSES

- | | | | | | |
|--|---|--|---|---------------------------------|--|
| <input type="checkbox"/> Accounting | <input type="checkbox"/> Advertising | <input type="checkbox"/> College Preparatory | <input type="checkbox"/> Foremanship | <input type="checkbox"/> French | <input type="checkbox"/> Railway Postal Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Commercial | <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Good English | | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Business Correspondence | <input type="checkbox"/> C. P. Accounting | <input type="checkbox"/> First Year College | <input type="checkbox"/> High School | | <input type="checkbox"/> Secretarial |
| <input type="checkbox"/> Business Management | | | <input type="checkbox"/> Illustrating | | <input type="checkbox"/> Showcard and Sign Lettering |
| <input type="checkbox"/> Cartooning | <input type="checkbox"/> Civil Service | | <input type="checkbox"/> Managing Men at Work | | <input type="checkbox"/> Traffic Management |

HOME ECONOMICS COURSES

- | | | |
|---|---|--|
| <input type="checkbox"/> Advanced Dressmaking | <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Tea Room and Cafeteria Management, Catering |
| <input type="checkbox"/> Foods and Cookery | <input type="checkbox"/> Professional Dressmaking and Designing | |

Name..... Age..... Address.....

City..... State..... Present Position.....

Canadian residents send coupon to International Correspondence Schools Canadian, Limited, Montreal, Canada
British residents send coupon to I. C. S., 71 Kingsway, London, W. C. 2, England

ONE THING TO DO BEFORE YOU BUY A CABINET HEATER



See the original and only genuine

Estate HEATROLA

Models for OIL, COAL and GAS

- Big. Beautiful. Modern. A handsome addition to your living room.
- Circulates healthful whole-house warmth. Keeps floors warm.
- Patented Intensi-Fire Air Duct saves fuel. Turns waste into warmth.

THE ESTATE STOVE CO., HAMILTON, OHIO

THERE IS ONLY ONE HEATROLA . . . ESTATE BUILDS IT

**"LOOK UP YOUR HEATROLA MAN...
HE'LL MAKE THINGS HOT FOR YOU"**

Contents [CONTINUED]

Useful Toolmakers' Clamps.....	189
Tap Wrenches for Your Tool Kit....	190
A Sliding-Sleeve Center Punch.....	191
Paint Striper Is Lettering Aid.....	192
Nutcracker Tool for Knurling.....	193
Twin-Carbon Arc Welding Torch....	194

Outdoors

Storing Your Boat for the Winter...	184
How to Save Storm-Damaged Trees.	186

Photography

Getting a Photographic Education...	206
Compact Pan-Tilt Tripod Head.....	211
Stabilizer Stops Sound Flutter.....	211
Control for Forty Flash Bulbs.....	211
Wide-Angle Lens Enlarges Field....	211
Self-Adjusting Color Camera.....	212
Club Films Feature-Length Movies..	213
Repairing Chipped Enamel Trays....	216
Film-Pack Fogging Prevented.....	216
Small Markers for Photo Slides....	216

Radio

Beginners' Two-Tube Superhet.....	202
Batteries Heat Soldering Tool.....	205
Impedance Unit for Automobiles....	205
Flexible Plastic Recording Disks....	205
Snap-In Fasteners Replace Screws...	205
Liquid Cleans Home Recordings.....	205
Interference Eliminator for Cars....	205

Shop Data File

Common Mortise-and-Tenon Joints..	165
What Craft Leathers to Use.....	168
Leather Designs and Patterns.....	169
Laying Out and Cutting Leather.....	169
How to Do Outline Tooling.....	169
Electroplating, Part 5.....	173
Setting a Lathe Threading Tool.....	193
Cored Carbon Welding Electrodes...	196

The Handy Man

Concrete Base for Floor Tiles.....	153
Mirrors Brighten Dark Kitchens....	156
Paper Plate Is Painting Catchall....	157
Record Player Housed in Table.....	165

Woodworking

Power Jointers Speed Up Planing...	158
Sewing Cabinet in Swedish Modern..	162
Colonial Signboard Mirror Frame...	164

**You need a Complete
Portable to do a
Complete Typing Job!**



TYPE better looking letters at greater speed on the Complete Underwood Champion Portable Typewriter.

The Underwood Champion with its 15 famous features of the big Underwood of business is the ideal portable typewriter for students, writers, professional men and women and those typists who want to develop speed by practicing at home.

Buy the Underwood Champion on the Easy Ownership Plan. Just a few dollars down and a year to pay the balance including a small carrying charge.

Underwood

PORTABLE TYPEWRITERS

**Ask your UNDERWOOD DEALER about these 15
Time-Tried Features or mail coupon**

1. Champion Keyboard, 84 Characters. 2. Left Side Back-Spacer. 3. Left and Right Carriage Release. 4. Right Margin Stop with Warning Bell. 5. Paper Release Lever. 6. Black and Red Ribbon. 7. Single, Double and Triple Line Spacer. 8. Paper Bail. 9. Variable Line Spacer. 10. Right and Left Shift Keys. 11. Sealed Action Frame. 12. Touch Tuning. 13. Paper Centering Scale. 14. Margin Release. 15. Keyboard Tabulator.

UNDERWOOD ELLIOTT FISHER COMPANY
One Park Avenue New York, N. Y.
Sales and Service Everywhere

UNDERWOOD ELLIOTT FISHER COMPANY
One Park Avenue, New York, N. Y.

Please give me full information on Underwood Portable Typewriters and your Easy Ownership Plan.

Name.....

Address.....

PSM-10-41

City..... State

Copyright 1941, Underwood Elliott Fisher Company



You'll Go Farther When You Know PLASTICS

Training in plastics will carry you into many modern industries—into fields in which fascinating opportunities are constantly developing. Now is the time to learn plastics—to gain knowledge that is in demand—to build a foundation for a profitable, permanent career.

Makers of automobiles, airplanes, furniture, radio and hundreds of other products are swiftly turning to plastics. Trained men have their choice of a wide range of industry.



With plastics training you can go farther in your chosen field. Become a plastics specialist—through Plastics ITI training. Courses are comprehensive, practical. You can train in the industry-type shops and laboratories at Plastics ITI, or start now in your own home.

If you are interested in training for one of the many careers available in plastics, write for complete information.

PLASTICS INDUSTRIES TECHNICAL INSTITUTE

194 South Alvarado Street
Los Angeles, California

PLASTICS INDUSTRIES TECHNICAL INSTITUTE

Please send information on—Plastics ITI training. I am interested in
☐ 1-year engineering course. ☐ Resident day course. ☐ Combination home study and resident training. ☐ Home study course.

Years High School? _____ College? _____

Name _____ Age _____

Address _____

City _____ State _____ S101

Coming Next Month—

HIGH-ALTITUDE BOMBING takes war pilots far up into the frigid solitudes of the sub-stratosphere, where just a short while ago only the most intrepid explorers of the air dared to go. How are men and machines conditioned against the cold and the rarefied air? What special equipment and training are needed? James L. H. Peck answers your questions in a splendid piece of scientific reporting.

ENEMY FLEET OFF U. S. COAST! If that headline should ever scream from our newspapers, the American people would have reason to be thankful for the little-known work of our Coast Artillery, which has ringed our shores with defensive works guarding industrial cities, naval bases, and other strategic points from Maine to Puget Sound. "Harbor Defense" gives a vivid picture of the work of this highly competent branch of our Army.

THERE'S A LOT more to keeping your car young than just getting the oil changed and having it greased at regular intervals, important as these things are. For there are many spots on the best of cars that are highly vulnerable to that archenemy of iron and steel—rust! To find out how you can protect such spots and thereby lengthen the life of your car, read the informative article, "Keeping Your Car Young."

WASTING HEAT in your home was never exactly the smart thing to do, but it will be more serious this winter than ever before, what with scarcities in some fuels and probable higher prices in all. A timely article tells you how to cut your fuel bills by reducing heat losses. Charts and diagrams based on engineering research show how much you can save by scotching various forms of heat waste.

WOOD plays a vital part in the defense program, and the scientists of the U. S. Forest Products Laboratory are working night and day to find new uses for this important material and to adapt it better to the jobs it has already. Hickman Powell tells how a laboratory-tailored crate for baby bombs is saving sailors' lives on the North Atlantic, how new drying methods make better lumber for military uses.

WHEN A DIRECTOR at the Twentieth Century-Fox Studios wants a special job of dramatic lighting for a scene, he calls for Arthur Miller to handle the photographing. Popular Science has persuaded this master cameraman to show amateur movie makers how to get telling effects with small, inexpensive lamps.

YES- I'M CONVINCED THAT I CAN MAKE GOOD MONEY IN RADIO. I'M GOING TO START TRAINING FOR RADIO RIGHT NOW.



NO- NOT ME. I'M NOT GOING TO WASTE MY TIME. SUCCESS IS JUST A MATTER OF LUCK AND I WASN'T BORN LUCKY.



BILL SAID "YES"
HE'S MAKING GOOD MONEY IN RADIO NOW



THIS N.R.I. TRAINING IS GREAT. AND THEY SENT REAL RADIO PARTS TO HELP ME LEARN QUICKLY

YOU CERTAINLY KNOW RADIO. MINE NEVER SOUNDED BETTER.



I'VE BEEN STUDYING RADIO ONLY A FEW MONTHS AND I'M ALREADY MAKING GOOD MONEY IN MY SPARE TIME

THANKS

OH BILL! I'M SO PROUD OF YOU. YOU'VE GONE AHEAD SO FAST IN RADIO

YES! I'VE GOT A GOOD JOB NOW AND A REAL FUTURE. THANKS TO N.R.I. TRAINING



TOM SAID "NO"
HE'S STILL WAITING FOR "LUCK"



BILL'S A SAP TO WASTE HIS TIME STUDYING RADIO AT HOME



SAME OLD GRIND -- SAME SKINNY PAY ENVELOPE -- I'M JUST WHERE I WAS FIVE YEARS AGO

GUESS I'M A FAILURE. LOOKS LIKE I'LL NEVER GET ANYWHERE

YOU'LL ALWAYS BE A FAILURE, TOM, UNLESS YOU DO SOMETHING ABOUT IT. WISHING AND WAITING WON'T GET YOU ANYWHERE



I will Train You at Home in Spare Time for a **GOOD JOB IN RADIO**

J. E. SMITH, President
National Radio Institute
Established 25 Years

Here is a quick way to more pay. Radio offers the chance to make \$5, \$10 a week extra in spare time a few months from now. There is an increasing demand for full time Radio Technicians and Radio Operators, too. Many make \$30, \$40, \$50 a week. On top of record business, the Radio industry is getting millions and millions of dollars in Defense Orders. Clip the coupon below and mail it. Find out how I train you for these opportunities.

Why Many Radio Technicians I Train Make \$30, \$40, \$50 a Week

Over 800 broadcasting stations in the U. S. employ thousands of Radio Technicians with average pay among the country's best paid industries. Repairing, servicing, selling home and auto Radio receivers (there are over 50,000,000 in use) gives good jobs to thousands. Many other Radio Technicians take advantage of the opportunities to have their own service

EXTRA PAY IN ARMY, NAVY, TOO

Every man likely to go into military service, every soldier, sailor, marine should mail the Coupon Now! Learning Radio helps men get extra rank, extra prestige, more interesting duty at pay up to 6 times a private's base pay.

or retail Radio businesses. Think of the many good pay jobs in connection with Aviation, Commercial, Police Radio and Public Address Systems. N.R.I. gives you the required knowledge of Radio for those jobs. N.R.I. trains you to be ready when Television opens new jobs. Yes, Radio Technicians make good money because they use their heads as well as their hands. They must be trained. Many are getting special ratings in the Army and Navy; extra rank and pay.

Beginners Quickly Learn to Earn \$5, \$10 a Week Extra in Spare Time

Nearly every neighborhood offers opportunities for a good part-time Radio Technician to make extra money fixing Radio sets. I give you special training to show you how

to start cashing in on these opportunities early. You get Radio parts and instructions for building test equipment, for conducting experiments that give you valuable practical experience. You also get a modern Professional Radio Servicing Instrument. My fifty-fifty method—half working with Radio parts, half studying my lesson texts—makes learning Radio at home interesting, fascinating, practical.

Find Out How I Train You for Good Pay in Radio

Mail the coupon below. I'll send my 64-page book FREE. It tells about my Course; the types of jobs in the different branches of Radio; shows letters from more than 100 of the men I trained so you can see what they are doing, earning. MAIL THE COUPON in an envelope or paste on a penny postal.

J. E. SMITH, President
Dept. 1KP3 National Radio Institute
Washington, D. C.

THIS **FREE** BOOK HAS SHOWN HUNDREDS HOW TO MAKE **GOOD MONEY**

J. E. SMITH, President, Dept. 1KP3
National Radio Institute, Washington, D. C.

Mail me FREE without obligation, your 64-page book "Rich Rewards in Radio." (No salesman will call. Write plainly.)

Name.....Age.....
Address.....
City.....State.....



From the
News Editor's
Desk

A NEW LIQUID COAL, mixed with 60 percent oil, makes a hotter fire than coal or oil alone. It promises an appreciable increase in the cruising range of ships, and it reduces fire risks because it can be stored under a water seal and may be extinguished by water. Dr. Walter M. Fuchs, professor of fuel technology at Pennsylvania State College, developed the new process of dissolving coal more completely than before. Bituminous coal is treated with acids to extract mineral matter and ash, and then dissolved in furfural, a common chemical available from farm waste such as corn cobs and bran. Manufacturers of resins and plastics may also utilize the new liquid, whose patent has been assigned to the Pennsylvania Research Corporation, an affiliate of the college.

A AMERICAN SMOKERS may soon be puffing on more pipes made of domestic materials and fewer imported products because of the war. A pipe factory at Boone, North Carolina, is working two shifts a day turning out pipe blocks of ivy, laurel, and rhododendron to replace briarwood formerly imported from France, Italy, and Algiers. And a Downs, Kans., inventor, has patented a method of making meerschaum, formerly imported from Asia Minor, with domestic magnesium silicate and the whites of eggs.

UNTIL RECENTLY, olive oil was just about the only substance considered acceptable for lubricating woolen fibers while they were being woven into fabrics. Then the European wars knocked holes in the olive-oil supply, and the woolen manufacturers began searching for a substitute. Now they have found that a mixture of mineral and coconut oils is even better. To make the story better, it costs the industry \$200,000 a year less.

SOLUTIONS OF PECTIN, the old stand-by for jelly making, have been injected into the veins in place of blood or blood plasma in cases of shock and hemorrhage, with good results, according to doctors at Henry Ford Hospital, Detroit. Such solutions are naturally easier to prepare and store than blood or plasma, and may prove the answer to the demand for large supplies of a solution that can be used for military purposes.

GLOWING SKIES, which have often clouded the plates of photographers working at night, may be caused by activity of the earth's magnetic field as well as by stars or moonlight, according to reports from California University's Lick Observatory. With this knowledge, it may be possible to pick good nights for astronomical picture taking by keeping tabs on the magnetic field to determine what nights will glow the least.



Will You Be Clerk or Manager Ten Years from Now?

"**S**URELY, this could never happen to me," you say—"that I should be sitting at the same desk—be doing the same work—for ten straight years!"

But wait a minute—

Exactly that same thing has happened to thousands upon thousands of men. It has probably happened to men right in the company you now are working for. And—unless you fit yourself for a better job—there is a very good chance that it may happen to you!

Unthinkable? That's what J. N. Dixon of Columbus, Ohio, said to himself. Yet lack of training kept him slaving away at low wages for a long time.

TRIPLES INCOME

Here is Mr. Dixon's own story—"Just after I returned from the war, one of your representatives found me plugging away at a bookkeeper's job in Marietta, Ohio. He performed a real service and explained to me the need of further training, and induced me to take the LaSalle training in Higher Accountancy. After a few months of study, I secured a position with the Trust Department of a National Bank. This was the stepping stone I needed to various responsible positions including handling of receiverships and other important duties. That quickly boosted my income several hundred percent."

ANOTHER AMAZING SUCCESS STORY

If you think Mr. Dixon's success story too unusual, read what J. H. Krouse of Memphis, Tennessee, says: "When I decided to take your training in Higher Accountancy, I was a clerk. Today I am Chief Consultant Accountant for the U. S. Engineer's Office in Memphis, Tenn. Whatever success or recognition I have had, I owe to your training. I have had no other specialized training along this line. Your method of teaching is not only instructive but highly engaging. I have observed other courses, but firmly believe LaSalle has the best to be had anywhere."

Another bit of evidence is Mr. R. P. Barthalow's experience. Mr. Barthalow is Chief of the Sales Tax Section of the Tax Commission of Ohio, a department which handles over \$50,000,000 a year. Mr. Barthalow attributes much of his success to LaSalle training.

SEND FOR These Two Books and Start Toward Bigger Success

Need you hear more before you investigate the opportunities in Accountancy?

Or will you face the problem of your future NOW—and send to LaSalle and get further facts and particulars?

Without cost or obligation, the coupon will bring you two interesting books—one a 48-page book entitled "Accountancy, the Profession that Pays"; the other "Ten Years' Promotion in One."

How about those next ten years—will you wait or will you START TODAY to realize the tremendous opportunities that may lie ahead of you through sound and practical home-study business training?

Measure your grit and ambition by what you do with this coupon—NOW.

LaSalle Extension University A CORRESPONDENCE INSTITUTE

Dept. 1083-HR, CHICAGO

Opportunities in Accountancy—Check below and we will send you a copy of "Accountancy, the Profession that Pays," also copy of "Ten Years' Promotion in One," all without obligation.

☐ **Higher Accountancy:** Leading to position as Auditor, Comptroller, Certified Public Accountant, Cost Accountant, etc.

Other LaSalle Opportunities: If more interested in one of the other fields of business indicated below, check that.

☐ Business Management
☐ Expert Bookkeeping
☐ C. P. A. Coaching
☐ Modern Salesmanship

☐ Traffic Management
☐ Law: Degree of LL. B.
☐ Industrial Management
☐ Modern Business Correspondence

☐ Stenotypy
☐ Business English
☐ Commercial Law
☐ Effective Speaking



Name..... Age.....

Present Position..... Address.....

Readers Say:

Wanted: Articles on the Navy with Gobs of Pictures

You publish a great many pictures of Army flyers, on and off duty. I wish you would

NOW YOU'RE TALKING, MATE!



print more pictures and facts about the U. S. Navy—not just Navy flyers, but of the sailors aboard ship and ashore. Show all the modern improvements of the ships. I enjoyed the article "Submarines in War," and am looking forward to more of the same kind of material.—J. G., Somerville, Mass.

Here's a Timely Reminder for Home Paper Hangers

IN YOUR excellent magazine I read with great interest Mr. Benjamin Nielsen's first article on wall-papering. Can't resist asking you to remind him to include in his next installment advice on avoiding that phase of the problem illustrated in the old story—where the craftsman's wife says, "Yes, it looks pretty nice, but what are those lumps?" To which the home paper hanger replies, "Gosh, I forgot to take down the pictures!"—A. S. C., Brooklyn, N. Y.

Would Birds Hang Out a Sign to Mark their Nest?

A FEW months ago, I made a bird-feeding platform half roofed over, with a weather-vane arrangement to turn it and keep the platform on the leeward side as a protection from the wind. Using some waste space, I made two apartments for nesting. These are on opposite sides, and one of them has been pre-empted by swallows. The birds evidently were confused by the shifting around of their abode, but have now hung several strands of weeds extending

GOSH, WHAT GOOD IS A SIGN IF I CAN'T LIGHT?



from their particular entrance, apparently to mark it. Will some nature lover tell me if I am right in my conjecture?—D. C. B., Kirkland, Wash.

An Article on Lubrication Would Please This Reader

ALTHOUGH I may have missed it, I haven't seen much if anything about auto lubrication in your magazine. This

is a large and important field. I think it would be a good idea to have an article covering types of oils and greases and answering questions such as whether oil is still good after use and whether it can be reconditioned. There are many facts about lubrication that require a lot of digging and I am sure that many of your readers would thank you for the information.—R. H., Baltimore, Md.

JUST ASK ME ABOUT IT!



He Wants More Ship Models Like Captain McCann's

How about some more ship models of the kind the late Captain McCann used to design? I have built his *Swallow* and *Alabama*. More models of this sort, I am sure, would hit the spot with the other thousands of ship-model makers whose tools and skill have been rusting since his death three years ago.—D. S., New York City.

One Thing Leads to Another—Now It's Old Alarm Clocks

C. C. M., of Burlington, Vt., asks what to do with his shirt cardboards. In our house we use them in place of dustpans. A friend of mine has made simple models of boats out of cardboard, and I think model railroads and planes could also be made. I use the cardboards in photography as masks and frames for films which I intend to use in a projector, if they are not too thick. I hope this helps C. C. M. Now will someone tell me what I can do with four broken alarm clocks, please?—E. J., Brooklyn, N. Y.

GOSH, MAYBE I'M NOT SUPPOSED TO WEAR THIS CARDBOARD!



Make or Break!

Car Engineers prove AC Spark Plugs on hills that are 12 months long

You'll never drive your car so hard,—or so long. But car engineers do it, day and night. Why? To get for you—among other things—the spark plug that is most reliable, most efficient, most satisfactory.

Out of brutal, killing tests like these comes AC leadership as the spark plugs for new cars and trucks. More AC Spark Plugs are used as factory equipment on new cars and trucks than any other make. And this has been true for the last 14 years.

That is why motorists who wisely follow the lead of car engineers say, "Give me AC's" when their service man suggests replacement of worn plugs.

These are AC Equipped for '41

Buick, Cadillac, Chevrolet, Nash, Oldsmobile, and Pontiac motor cars; Chevrolet, Diamond T, Federal, GMC, and International Trucks; Allis-Chalmers, J. I. Case, Cletrac and International Harvester Tractors... these are some of the well-known cars, trucks and tractors which use AC Quality Spark Plugs. Trust your spark plug requirements to the same brand of spark plugs which the leading, big-volume manufacturers select.

*New AC's every 10,000 miles will
more than pay for themselves*



How To Continue GOOD PLUG PERFORMANCE



Have your Registered AC Cleaning Station clean, check, and re-gap your spark plugs every 4,000 miles. This service costs only 5c a plug. Clean plugs mean more power—as much as 21%.

Get Plugs CLEANED where you see this Sign



AC SPARK PLUG DIVISION · GENERAL MOTORS CORPORATION · FLINT, MICHIGAN

OCTOBER, 1941

Please mention POPULAR SCIENCE MONTHLY when writing to advertisers.

15

FOR SHOP TOOLS- FOR MODELS

• TOOLS LAST LONG and models run smoothly with MOBIL HANDY OIL. It lubricates and helps prevent rust. Penetrating, non-gumming. Excellent for garden tools and home appliances. Free wall clip with every can.



MOBIL HANDY OIL

For Your Car's Finish



• MOBILGLOSS is double-acting—cleans and polishes at the same time. Makes dirt, grime, and road film disappear. Brings back the original color and lustre of the car's finish. Quickly polishes up to a brilliant gloss. Saves you time and work.

MOBILGLOSS

Buy Where You Buy
Mobiloil or Mobilgas



MOBIL SPECIALTIES

Mobilgloss • Mobil Stop-Leak • Mobil Radiator Flush
Mobil Hydrotone • Mobil Handy Oil • Mobil Upperlube
Mobil Window Spray • Mobilwax • Mobil Spot Remover

BY SOCONY-VACUUM

Readers Say:

The Artist Was Thinking About Something Else

WONDER WHERE LOTTIE
WANTS TO GO THIS TIME
ON MY VACATION?



IN YOUR August issue you seem to have adopted what is now the general usage for spelling "bulb," namely "BLUB." It appears on page 188, in the schematic diagram of the light-beam transmitter. We have jokingly used this term in the electrical line, but I never thought I

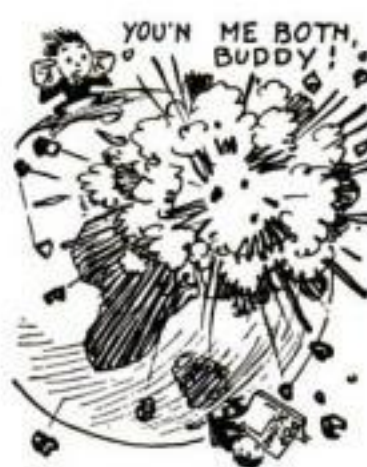
would see it in P.S.M.—L.A.W., New Haven, Conn.

He May Have Got the Fracture While Riding a Nightmare

As a lay instructor on first aid for the Red Cross, I was pleased to note that the fracture case you showed in your article "Motorizing the Medical Corps" had obligingly had his fracture while lying on a stretcher with a pillow under his head. Or so it would seem, because one of the first things we teach about fractures is: "Never move a fracture case until splints are applied." Since these beautifully trained Medical Corps men are in the act of applying a traction splint to the leg of the victim, it is to be assumed that the fracture took place in this very convenient position.—Mrs. M. F. F., Roswell, N. M.

Hopes the War Will Cease —and Don't We All?

I HAVE only recently begun reading your most interesting magazine, and am writing to tell you how much I appreciate the useful information printed by P. S. M. I shall be extremely sorry if the war causes importation of P.S.M. here to cease, so we'll just hope the war ceases instead. In the meantime, thumbs up, P. S. M.!—H. K. S., Hamilton, New Zealand.



SAVE UP TO
50%

FACTORY-TO-YOU

**FREE "RED HEAD" BOOSTER
AERIAL**
WITH THIS CHASSIS (For A Limited Time Only)



Now... **YOU CAN'T Miss THOSE
THRILLING FOREIGN STATIONS**

with the **New 1942 MIDWEST
SUPER BAND SPREAD CHASSIS!**

MIDWEST'S NEW METHOD
PLENTY OF ROOM
BETWEEN STATIONS
Easy To Tune

ORDINARY METHOD
STATIONS CROWDED
Very Hard To Tune

**NOT JUST 3 BANDS
NOT JUST 4 BANDS..
NOT JUST 5 BANDS, BUT...**

9 BANDS

(ON SIX DIAL SCALES)

\$19⁷⁵

COMPLETE
CHASSIS

**With Speaker, Tubes, Push
Button Tuning ... Magna
Tenna Loop Aerial ...
Ready To Plug In and Play**

**ENJOY
20 TIMES
EASIER
TUNING...**



**PUT THIS NEW CHASSIS
IN YOUR PRESENT CABINET!**

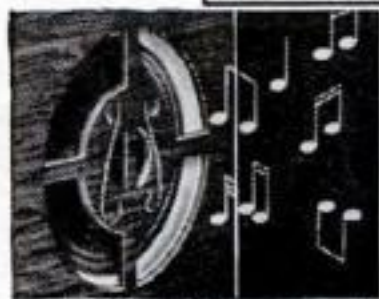
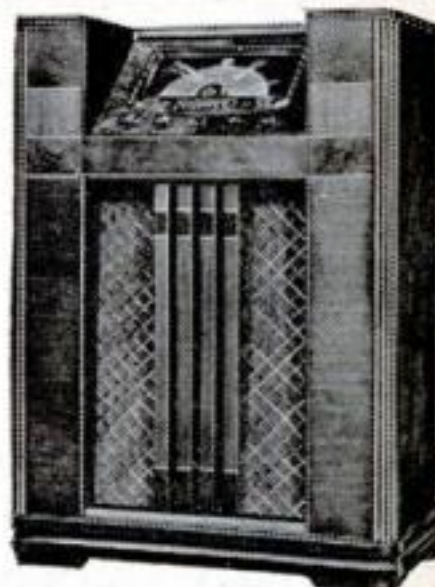
**UP TO \$50 TRADE-IN ... on Many
TO 1942 Models**

YOU GET the wholesale factory-to-you price when you buy direct from Midwest—you save up to 50%—and you secure so much more in performance and in radio realism. Midwest offers many sensational new features, this year, including—**exclusive** (in popular-priced radios) **BAND SPREAD TUNING** which makes Midwest radios 20 times easier to tune. Enjoy fascinating entertainment with a Midwest automatic record-playing 8, 11, or 16-tube radio-phonograph. Write today for big, **FREE** catalog, featuring many beautiful 1942 factory-to-you radio chassis and console values—from 5 to 16 tubes—including Automatic Record-Changing Radio-Phonographs, Home-Recorder, etc.—from \$12.95 to \$212.50.

**30
DAYS
TRIAL**

E-Z TERMS

**16-TUBE MODEL "Y" IS
SHOWN AT RIGHT.**



**Acousti-Sonic Louvres with
Violin-Type "F"-Slot Sound-
ing Board ... spread the
High Fidelity tones scientific-
ally throughout the room.**

**FILL IN COUPON AND MAIL TODAY OR JUST
SEND YOUR NAME AND ADDRESS ON 16 POSTCARD**

MIDWEST *factory-to-you* RADIOS

MANUFACTURERS OF QUALITY RADIOS SINCE 1920

Midwest Radio Corporation
Cincinnati, Ohio, U. S. A.
Dept. ... 59-E

Send me your new **FREE**
Catalog, complete details of
your liberal 30-day Trial offer
and factory-to-you prices.

Name.....

Address.....

Town..... State.....

User-Agents Make Easy Extra Money. Check here () for details.

**MIDWEST RADIO CORPORATION
DEPT. 59-E
CINCINNATI, OHIO**

\$10⁰⁰ SAVED per dollar spent—a fair average for SMOOTH-ON No. 1

Look down the column illustrating some of the different kinds of leaks that can be sealed by Smooth-On and you will get some idea of the variety of ways in which Smooth-On can save you money. In many a home, a simple Smooth-On repair has avoided a costly bill for new parts and replacements on heating systems, water lines, and apparatus.

On innumerable small jobs, too—the breakages, leaks and loose parts that happen right along in every household—Smooth-On can save you an amazing amount of money in the course of a year. That's why a tin of Smooth-On is considered just as important as a hammer or screw driver in homes and shops all over the country.

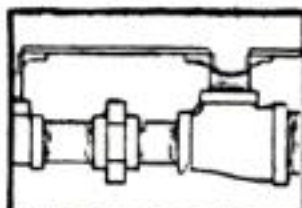
FREE

40-Page Handbook Shows How

We have prepared a concise practical repair manual describing ingenious and money-saving repairs that you can do with Smooth-On. Many of the hints in this booklet are not published elsewhere, and you will find them immensely helpful. To obtain your free copy, just send us the coupon with your name and address on a postal card.



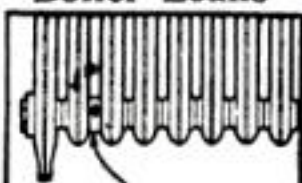
Get Smooth-On No. 1 in 1 3/4-oz., 7-oz., 1-lb. or 5-lb. tins at nearest hardware store, or if necessary direct from us.



Pipe Leaks



Boiler Leaks



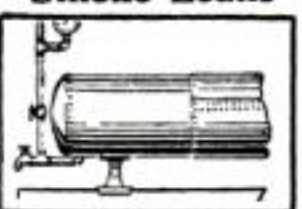
Radiator Leaks



Fire Pot Leaks



Smoke Leaks



Tank Leaks



Furnace Gas Leaks

SMOOTH-ON MFG. CO.,
574 Communipaw Ave.,
Dept. 58, Jersey City, N. J.

Please send Smooth-On Repair Book.

Name.....

Address.....

10-41.....



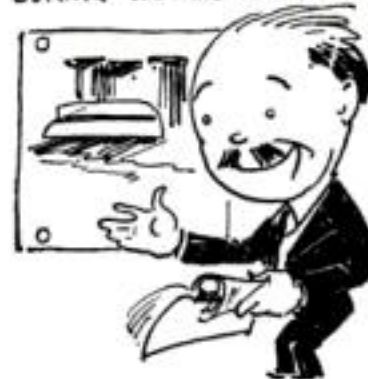
Do it with SMOOTH-ON

Readers Say:

Everything Else Is Topsy-Turvy, So Why Not Shipbuilding?

If I knew more about boats and boat building, I probably wouldn't be writing this letter to you. I live in a community where many small boats are built, and they are all built with the bottom side up. Why, I ask, couldn't this be done with ships—probably not with the largest, but at least with the medium-sized craft? My plan, take it for what it is worth, is this: Lay out the top deck on the floor of a dry dock, and work up to the bottom. When the hull is completed, let into the dock enough water to make the ship sufficiently light to roll over.—J. S. H., Laconia, N. H.

CONCRETE BOATS WERE BUILT THAT WAY DURING WORLD WAR ONE



We Almost Had It Before It Happened

POP SCIENCE SEES ALL, KNOWS ALL, SELAH!



SCIENCE up to the minute—that's P.S.M.! In less than a week after the B-19, world's largest airplane, made its test flight, Pop. Sci. publishes pictures of it taxiing down the field. Can't ask for better service.—G. T., Conneaut, Ohio.

Our photos were taken during a taxiing test, some time before the flight test.—Ed.

That Floating Hockey Puck Wouldn't Be Cricket

PLEASE tell D.S. and P.M. to go jump in that hole in the ice. If they want to play juvenile hockey they can make their pucks from wood, but regular hockey calls for regulation pucks. "The puck shall be a vulcanized black rubber disk, uniformly one inch in thickness and three inches in diameter, weighing from 5 1/2 to six ounces, and free from cuts and indentations." A simple calculation shows that a puck of this required size and weight would necessarily have a specific gravity greater than 1, and therefore would sink.—H. C., Columbus, Ohio.

SAVES TIME ...MANY TIMES A DAY!



MENDS: Torn book pages, sheet music, maps, blue prints, window shades, transparent curtains.



SEALS: Snapshots in albums; packages, boxes and bags; labels to cans, bottles and drawers.



HOLDS: Windings to golf clubs; clippings in scrap-books, jig saw patterns, shelf paper in place.



FIXES: Broken model planes, dolls and other toys, fly rods, tears in movie films.

Use Scotch Tape to save time and trouble in dozens of ways—mending, sealing and holding. Transparent as glass, Scotch Tape seals with a touch of the finger. At Stationery, Drug, Department, Hardware, and 5 & 10c Stores.

Write for **FREE BOOKLET**—Scotch Tape, 900 Fauquier Ave., Dept. PS101, Saint Paul, Minnesota.



25c with $\frac{1}{2} \times 360$ inch roll. "Look for the name Scotch Tape."

SCOTCH Cellulose TAPE

SEALS WITHOUT WATER • TRANSPARENT AS GLASS

Copyright 1941, Minnesota Mining & Mfg. Co.
MADE & PATENTED IN U. S. A. BY MINNESOTA MINING & MFG. CO., SAINT PAUL, MINNESOTA.
SOLD IN FOREIGN COUNTRIES UNDER THE NAME "DUREX" CELLULOSE TAPE. FOREIGN MFRS.
& DISTRIBUTORS: FOR CANADA—CANADIAN DUREX ABRASIVES, LTD., TORONTO. FOR ALL
OTHER COUNTRIES—ADDRESS DUREX ABRASIVES CORP., 63 WALL ST., NEW YORK, N. Y.



with a
HARLEY-DAVIDSON

GOOD TIMES *You'll Never Forget*

You open up a whole new world of fun, excitement and adventure when you own a Harley-Davidson. Its "cruising range" brings famous outdoor beauty spots closer — so inexpensive to reach. And your smart, powerful Harley-Davidson is your "passport" to join new friends in plenty of good times at gypsy tours, hill-climbs, race meets, and other thrill-packed motorcycle events. See your Harley-Davidson dealer — ask about his Easy Pay Plans.



HARLEY-DAVIDSON
WORLD'S CHAMPION MOTORCYCLE

MAIL COUPON NOW

HARLEY-DAVIDSON MOTOR CO., Dept. P.S., Milwaukee, Wis.
Send **FREE** copy of big 24-page "Enthusiast" magazine filled with thrilling motorcycle pictures and stories. Also literature on the new Harley-Davidsons. Stamp is enclosed for mailing cost.

Name.....

Address.....

JUST BECAUSE ONE MAN
DOESN'T KNOW SANI-FLUSH
CLEANS OUT RADIATORS



Clean out car radiators. Avoid overheating. Sani-Flush does it chemically. Loosens scale and rust. Lets water circulate. It costs only 10c. (25c for the largest truck or tractor.)

Do the job yourself—or have your service station do it. Plain water isn't enough. Insist on Sani-Flush. Can't harm aluminum cylinder heads. It's used in most bathrooms for cleaning toilet bowls. (Directions on can.) Sold by grocery, drug, hardware and 5-and-10c stores. 10c and 25c sizes. The Hygienic Products Co., Canton, Ohio.

Sani-Flush
CLEANS OUT RADIATORS

**MEN! GET IN ON
THIS EASY Money-Maker!**

**HUGE PROFITS EASY IN NEW
UNLIMITED MARKET!**

Stop working for dimes! Be independent—and count profits in DOLLARS demonstrating and selling patented low-priced KANT-SLAM Door Check. Amazing invention STOPS SLAMMING DOORS! Closes doors silently, surely, automatically. Hydraulic action—rarely needs attention. Lasts years. Easily installed. Real Demonstrator offered. Get easy, quick orders demonstrating actual sample on easy-to-carry miniature door. Every office, store, factory, school and public building can use KANT-SLAM. Liberal commission on every order. Rush name, address today for big-profit Plan. **KANT-SLAM, Dept. P-88 Bloomfield, Indiana**



Readers Say:

P.S.M. Started Him Off with a Metalworking Lathe

FOR the last 10 or 11 years I have been buying your magazine, and it is the finest publication of its kind that I have had the pleasure to read. Personally, I would like more articles in your Home Workshop section dealing

with the making of tools such as squares, micrometers, and center heads. I realize that one could not expect 100-percent accuracy from these home-made tools, but they are so infernally expensive to buy in this country—in fact unprocureable in many cases at the present time—that the work-

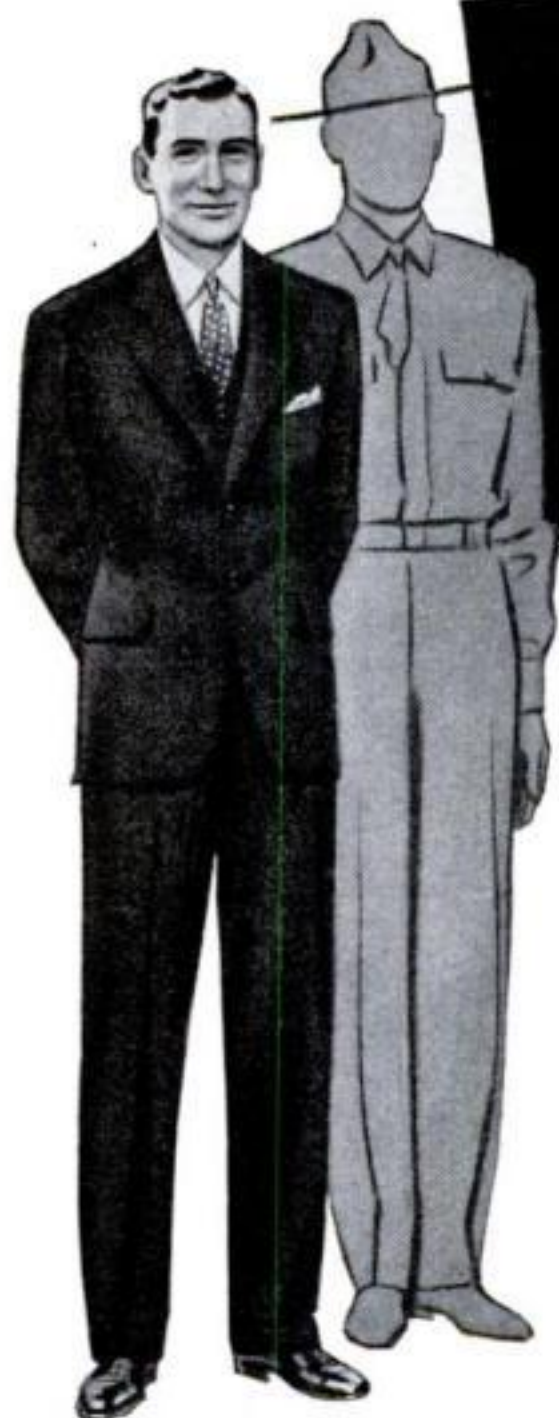
YOU'LL HAVE TO MAKE
ROOM FOR MY NEW
TOOLS, JUNIOR!



er with a small lathe is hard put to get hold of them. It was your publication that fired me with the desire to own a metalworking lathe, and since I have obtained one I get much assistance from your magazine for the hours of fun it gives me. I wish P.S.M. a long life.—E. C. W., Sydney, Australia.

Fish Thrive on Freezing in Colorado Garden Pool

IN YOUR August issue you state that "fish can survive freezing temperatures in a garden pool 36 inches or more deep unless the water remains frozen to a depth of three or four inches for several days, in which case the fish will suffocate." I have a pool that is approximately five feet in diameter and about two feet deep. Our goldfish remain in the pool the entire year. In the fall, I put a two-by-four about five feet long in the pool and let it lie there, with about two feet extending over the tile bank. While our temperatures range from 95 above to 30 below, the pool has never suffered from the effects of freezing, and the fish in the spring always appear to be 30 percent larger than before the winter freeze. We do, however, make it a point to see that the fish are well fed before the final freeze (using regular oatmeal). This pool is frozen over from late November to late March and at times, without doubt, is frozen solid. Yet the fish are always alive in the spring.—F. C. H., Boulder, Colo.



What about I.C.S. students who are drafted?

MAYBE you've learned that only with *proper training* can you hope to get ahead on your job — maybe you've often said, "Some day I'll take an I. C. S. Course, and really amount to something!"—but because of the draft, you've decided to put it off. *Don't do it!*

If you're drafted, you'll be encouraged to continue your I. C. S. studies — for the U. S. Army, like business and industry, needs trained men—and *pays them well!* Furthermore, you will have real training by the time your term of enlistment is over, and you'll be ready to step into a bigger, better-paying job than you have now.

Figure it out for yourself — training pays in peacetime or war-time, in army or civilian life. Mail this coupon *right now* for information on low-cost I. C. S. Courses in your line of work. *The I. C. S. Limited is headed for Success — climb on!*

INTERNATIONAL CORRESPONDENCE SCHOOLS CELEBRATE 50 YEARS OF SERVICE TO AMBITIOUS AMERICANS

1891★1941

BOX 7617-K, SCRANTON, PENNA.



Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course *before* which I have marked X:



TECHNICAL AND INDUSTRIAL COURSES

- | | | | | | |
|---|--|---|---|--|--|
| <input type="checkbox"/> Agriculture | <input type="checkbox"/> Air Brake | <input type="checkbox"/> Contracting and Building | <input type="checkbox"/> Marine Engines | <input type="checkbox"/> R. R. Signaller | <input type="checkbox"/> Refrigeration |
| <input type="checkbox"/> Air Conditioning | | <input type="checkbox"/> Cotton Manufacturing | <input type="checkbox"/> Mechanical Drafting | <input type="checkbox"/> Sanitary Engineering | |
| <input type="checkbox"/> Airplane Drafting | | <input type="checkbox"/> Diesel Engines | <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Sheet Metal Work | |
| <input type="checkbox"/> Architectural Drafting | | <input type="checkbox"/> Electrical Drafting | <input type="checkbox"/> Mine Foreman | <input type="checkbox"/> Ship Drafting | <input type="checkbox"/> Shop Practice |
| <input type="checkbox"/> Architecture | | <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Navigation | <input type="checkbox"/> Steam Electric | <input type="checkbox"/> Steam Engines |
| <input type="checkbox"/> Auto Engine Tune-up | | <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Patternmaking | <input type="checkbox"/> Steam Fitting | |
| <input type="checkbox"/> Auto Technician | | <input type="checkbox"/> Foundry Work | <input type="checkbox"/> Pharmacy | <input type="checkbox"/> Structural Drafting | |
| <input type="checkbox"/> Aviation | <input type="checkbox"/> Aviation Mechanic | <input type="checkbox"/> Heating | <input type="checkbox"/> Plumbing | <input type="checkbox"/> Structural Engineering | |
| <input type="checkbox"/> Boilermaking | | <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Poultry Farming | <input type="checkbox"/> Surveying and Mapping | |
| <input type="checkbox"/> Bridge Engineering | | <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> Practical Telephony | <input type="checkbox"/> Telegraph Engineering | |
| <input type="checkbox"/> Chemistry | | <input type="checkbox"/> House Planning | <input type="checkbox"/> Public Works Engineering | <input type="checkbox"/> Telephone Work | |
| <input type="checkbox"/> Civil Engineering | | <input type="checkbox"/> Locomotive Engineer | <input type="checkbox"/> Radio, General | <input type="checkbox"/> Textile Designing | <input type="checkbox"/> Toolmaking |
| <input type="checkbox"/> Coal Mining | | <input type="checkbox"/> Machinist | <input type="checkbox"/> Radio Operating | <input type="checkbox"/> Welding, Electric and Gas | |
| <input type="checkbox"/> Concrete Engineering | | <input type="checkbox"/> Management of Inventions | <input type="checkbox"/> Radio Servicing | <input type="checkbox"/> Woolen Manufacturing | |
| | | <input type="checkbox"/> Mfg. of Pulp and Paper | <input type="checkbox"/> R. R. Section Foreman | | |

BUSINESS COURSES

- | | | | | | |
|--|--|--|---|---------------------------------|--|
| <input type="checkbox"/> Accounting | <input type="checkbox"/> Advertising | <input type="checkbox"/> College Preparatory | <input type="checkbox"/> Foremanship | <input type="checkbox"/> French | <input type="checkbox"/> Railway Postal Clerk |
| <input type="checkbox"/> Bookkeeping | | <input type="checkbox"/> Commercial | <input type="checkbox"/> Good English | | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Business Correspondence | | <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> High School | | <input type="checkbox"/> Secretarial |
| <input type="checkbox"/> Business Management | | <input type="checkbox"/> C. P. Accounting | <input type="checkbox"/> Illustrating | | <input type="checkbox"/> Showcard and Sign Lettering |
| <input type="checkbox"/> Cartooning | <input type="checkbox"/> Civil Service | <input type="checkbox"/> First Year College | <input type="checkbox"/> Managing Men at Work | | <input type="checkbox"/> Traffic Management |

HOME ECONOMICS COURSES

- | | | |
|---|---|--|
| <input type="checkbox"/> Advanced Dressmaking | <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Tea Room and Cafeteria Management, Catering |
| <input type="checkbox"/> Foods and Cookery | <input type="checkbox"/> Professional Dressmaking and Designing | |

Name..... Age..... Address.....

City..... State..... Present Position.....

Canadian residents send coupon to International Correspondence Schools Canadian, Limited, Montreal, Canada
British residents send coupon to I. C. S., 71 Kingsway, London, W. C. 2, England

New!

6 AVIATION

BIG BOOKS SHIPPED free

for examination



★ This brand new cyclopedia "AVIATION" is just off the press and is the finest, best illustrated and most complete cyclopedia on this subject we have ever published. Beautifully bound in modernistic washable cloth. Covers the whole field from first principles of flight through latest types of engines, meteorology, aircraft instruments and how to read them, gliding, parachute packs, etc. Every man interested in flying, whether amateur or expert, should have these books; sent for free examination, no money down, no deposit.

Wonderful New Field

National Defense has opened up tremendous opportunities in Aviation. It is the fastest growing industry today. Huge new plants are being built. Get into this field now. Send the coupon for free examination. Get this brand new up-to-the-minute cyclopedia NOW.

American Technical Society, Dept. H-720
Drexel at 58th St., Chicago, Ill.

Send for 10 days' trial brand new 6 volume set, Aviation. I will pay the delivery charges only. If I wish I may return books in ten days and owe you nothing, but if I decide to keep them I will send \$2.00 after 10 days, then only \$3.00 a month until \$19.80, the total price, is paid. Send brand new edition which includes Aviation Blueprint Reading and free consulting service for one year.

Name.....

Address.....

Please attach letter, stating age, occupation, employer's name and address and that of at least one business man as a reference.

TRAIN FOR Radio in 8 WEEKS

I WILL FINANCE YOUR TRAINING

Prepare for opportunities in Radio by 8 weeks of practical shop work in the great Coyne Radio Shops, on real RADIO equipment. You don't need advanced education or experience. Free Employment Service for life. Many earn while learning. Mail coupon today for free book which tells you how hundreds have become successful Radio Men after taking our training.

H. C. LEWIS, Pres., RADIO DIV., Coyne Electrical School
500 S. Paulina St., Dept. 71-4H, Chicago, Illinois

Send Free Radio Book and facts. Tell me about your "Pay-Tuition-After-Graduation" Plan.

NAME.....

ADDRESS.....

CITY..... STATE.....

MAKE BIG MONEY at HOME!

NEW INVENTION

Electroplates by Brush



FREE SAMPLE and BOOKLET EXPLAINS ALL

New, patented invention makes possible big earnings AT HOME. Replate auto-parts—worn articles in homes, stores, hotels, restaurants, etc., with durable, sparkling, new coat of metal—with stroke of brush. Easy, simple, quick. Genuine Gold, Silver, Nickel, Cadmium, etc. Everything furnished. Outfit complete, ready for use. No shop required. Clear from \$2 to \$5 an hour in lifetime business. Small investment starts you in business. Steady repeat. Machine can pay for itself in week. Send TODAY for FREE SAMPLE and illustrated BOOKLET how you can have a life income from a business of YOUR OWN built upon satisfied customers. Act at once!

WARNER ELECTRIC COMPANY
225 N. Wabash Ave., Chicago, Ill., Dept. 2-T

Please mention POPULAR SCIENCE when writing to advertisers.

Millions of Ordinary Jobs... Scores of Thousands of Preferred Jobs

WHICH DO YOU WANT?

The industrial and business boom makes it possible to get the job you want—if you are trained or will get ready for it. The millions of men going back to work have created hundreds of thousands of openings for specialists and supervisors—jobs as foremen, superintendents, production men, accountants, salesmen, trafficmen, department managers, executives, preferred jobs of every kind. And there aren't enough men ready for these jobs. That is your opportunity if you will prepare quickly. We can help you. Our training is condensed, practical, moderate in price. You train at home in spare time—as fast as you wish. Write for free 48-page booklet on the field in which you are interested. Remember—the quicker you act, the better will be your opportunity.

LASALLE EXTENSION UNIVERSITY
A Correspondence Institution
Dept. 1083-R CHICAGO, ILL.

ENGINEERING DEGREE IN TWO YEARS

B. S. Degree courses in engineering: Electrical, Civil, Chem., Mechanical, Radio or Aeronautical. 1 yr. Mech. Drafting. Approved by Civil Aeronautics Authority, participation in Pilot Training Program. Large industrial center. Prep courses without extra charge. Earn board if desired. Low tuition. Enter December, March, June, September. Write for Catalog.

6101 E. Washington Blvd., Fort Wayne, Ind.

INDIANA TECHNICAL COLLEGE

RADIO COURSES

Radio Operating—Radio Servicing—Amateur Code Classes
Electronics—1 yr. day course; 2 yrs. eve.

AUTO MECHANICS Repair, Electricity, Shop Principles
Air Conditioning—Refrigeration—Motion Picture Operating

DRAFTING (Mechanical Drawing—Blue Print Reading)

Y. M. C. A. TRADE & TECHNICAL SCHOOL
10 W. 63rd St. New York, N. Y.

Learn AUTO-DIESELS

Practical, tested training. Backed by 36 years experience. Course includes Auto Mechanics, Diesel Service and Operation, Diesel Power Generation, Machine Shop Practice, Auto Electrics, etc. Flexible plan to meet specific needs of those with or without jobs. Oldest, largest trade school in West qualifies you and helps you get a good pay job. Transportation allowed to L. A. Earn room and board while learning. Request Free Catalog.

NATIONAL SCHOOLS Dept. 10-PSA
Los Angeles

EARN A DEGREE AT HOME

From A Chartered Educational Institution

Conducted by Correspondence

Degree Courses in Arts; Sciences; Philosophy; Education; Public Health; Medical Jurisprudence; Psychology; Sociology; Physics; Chemistry; Geology; Pol. Science; Theology; Law; Business Training; Accounting; Statistics; Agriculture; Engineering; Electrical; Civil; Mechanical; Drafting; Architectural; Automotive; Steam; Diesel; Aeronautical; Radio; Structural; Industrial; Highway; Petroleum; Mining; Marine; Refrigeration; Air Conditioning; Chemical. Founded 1908. Chartered.

McKinley-Roosevelt Foundation, 4610-AF Sheridan Road, Chicago

Get into the BAKING BUSINESS

Bakers make good money! Now 7th Industry in wages! Nearly depression-proof. New home study Baking Course qualifies you. Common school education sufficient. If you're ambitious, write for FREE BOOK, "Opportunities in Baking." National Baking Institute, 1315 Michigan, Dept. 1367, Chicago



ARTISTS MAKE MONEY

Find out your ability. Send name, age, occupation and address for Free Vocational Art Test.

Federal Schools, Inc., 10141 Federal Schools Bldg., Minneapolis, Minn.

AUTO-MECHANICS & WELDERS

Auto Mechanics and Welders are in big demand. Complete courses in arc and acetylene welding, body and fender bumping, spray painting and metal finishing. Pay after graduation plan. Special low rates. Write today.

MICHIGAN TRADE SCHOOL
3720 Woodward Ave., Detroit, Mich.

FREE 32 PAGE CATALOG

INVENTORS!

Read HOW CLARENCE A. O'BRIEN
MADE IT *EASY* FOR ME TO
PATENT AND SELL MY INVENTION



THE AMAZING SUCCESS STORY OF A. L. M.
(name on request) TOLD HERE IN HIS OWN WORDS

"I AM glad to tell the story of how I got started on the road to my present success, because I feel certain that it will be of real interest and possible inspiration to other inventors who are just starting out.

While attending a technical school I became very much annoyed with the inadequacy of one of the tools required in the course of my study. As a result I conceived an idea for an improvement which I felt so surpassed the tool then used, that I was certain other students and professional men would find it very valuable. I demonstrated it to my friends and they were so greatly impressed with its commercial possibilities, that they advised me to get a patent on it.

Acting immediately upon this suggestion, I wrote to Clarence A. O'Brien, having been advised that he was a reliable and competent registered patent attorney. Following prompt instructions from Clarence A. O'Brien, I submitted my invention to him for the purpose of making a preliminary patentability search of the Patent Office records. The good word soon came back . . . my invention appeared to be patentable! I believe that this was one of the greatest moments of my life. Armed with this assurance, I promptly filed application for a patent. As soon as the patent was thus pending, I was in a position to commence volume production of my invention. I then arranged an interview with one of the largest manufacturers in the business, and demonstrated the model to him, since in the meantime

Clarence A. O'Brien had secured the necessary patent for my invention. The manufacturer was so favorably impressed, that he gave me a substantial order. He was so pleased with the sales results of my invention that he is now reordering in great quantities. Other manufacturers caught up the idea, and today I am supplying most of the market, and am protected against infringement by the patent obtained through the efforts of Clarence A. O'Brien.

I feel that the whole basis of my good fortune may be traced to the intelligent, careful cooperation of Clarence A. O'Brien in securing a patent on my invention. Without the assistance of Clarence A. O'Brien, my tremendous success would not have been possible . . . I can whole-heartedly recommend his services to any inventor who has an idea worth protecting by a U. S. Patent."

A PATENT IS YOUR FIRST STEP

If you would protect yourself against the scheming activities of unscrupulous imitators, a patent obtained from a reliable registered patent attorney is a very necessary prerequisite. Do not be misled by claims that protection may be secured by any method other than a U. S. Patent . . . and do not run the risk of obtaining your patent through the services of anyone other than a registered patent attorney. Clarence A. O'Brien is a registered patent attorney before the U. S. Patent Office, and is qualified by more than twenty years of actual patent law practice to give you the kind of service you deserve. Remember, a patent . . . as such . . . is valueless, unless it specifically protects you . . . but good claims . . . against infringement by imitators. Every member of Clarence A. O'Brien's staff is completely qualified to help in giving you every service that can contribute toward patent protection.

DEFENSE INVENTIONS

Inventions which might be considered of value to National Defense, are given special attention, even to the extent of assisting in submitting to proper authorities.



Mail Coupon
for FREE
PATENT GUIDE AND
RECORD OF
INVENTION
FORM

CLARENCE A. O'BRIEN
"Worthy of your Trust"
REGISTERED PATENT ATTORNEY
WASHINGTON, D. C.

ACTION IS IMPORTANT *Mail Now*

CLARENCE A. O'BRIEN

Registered Patent Attorney
before the United States Patent Office

Dept. 1K2, Adams Building, Washington, D. C.

Please send me your 48-Page Patent Guide and your specially prepared "Record of Invention" form FREE. This request does not obligate me.

Name.....

Address.....

City.....State.....

(Please write or print plainly)

AVIATION PILOTS Wants more MECHANICS ENGINEERS

Prepare NOW to earn as high as \$3000 to \$5000 a year as Pilot, Mechanic or Aeronautical Engineer. Lincoln trains you not only for immediate essential employment in National Defense, but for a **LIFETIME CAREER** in Aviation.

BE AN AERONAUTICAL ENGINEER. Help Design and Build needed Airplanes. Big demand. High Pay. Many earn up to \$4000 a year. High School education sufficient.

BE A PROFESSIONAL PILOT. Our Commercial Pilot Graduates in great demand. Start as high as \$3000 to \$3600 a year. Rapid advancement. All Flight Training **Government Approved**, BOTH Primary and Advanced.

BE A SKILLED MECHANIC. Lincoln's **Government Approved Mechanics Training** prepares for Gov't Rating as A & E Mechanic and immediate employment with Airline, Airport or Factory. Big demand. Pays \$1500 to \$2400 a yr.

MAIL COUPON NOW for complete information. Learn about essential defense positions now open in civilian Aviation.

Train at
LINCOLN



LINCOLN AERONAUTICAL INSTITUTE

Lincoln Aeronautical Institute,
6310 Aircraft Building, Lincoln, Nebraska

Tell me how I can prepare BOTH for immediate civilian employment essential to National Defense and also for a Lifetime Career in Aviation.

NAME.....

ADDRESS.....

CITY.....STATE.....

Learn PHOTOGRAPHY at Home

Splendid opportunities. Prepare in spare time. Easy plan. No previous experience needed, common school education sufficient. Send for free booklet "Opportunities in Photography", particulars and requirements.

American School of Photography
1315 Michigan Ave., Dept. 1367, Chicago, Ill.

WORLD'S LARGEST DENTAL PLATE MAKERS

\$6⁸⁵ to \$35⁰⁰

FALSE TEETH



LOWEST PRICES
SEND NO
MONEY



Professional Model

try...

our dentures set with pearly-white genuine porcelain teeth; constructed from high-grade materials, with expert workmanship to give long service. We make all styles of plates.

DENTAL PLATES by Mail

We make to measure for you individually—by mail—Dental Plates for men and women—from an impression of your own mouth taken by you at home.



TRANSPARENT

By reading our catalog, learn how to save **ONE-HALF** or more on false teeth. Send for it Today!

ON 60 DAYS' TRIAL

Make us **PROVE** every word we say. Wear our teeth on trial for as long as 60 days. Then, if you are not perfectly satisfied with them—they will not cost you a cent. We take your word! Orders promptly and carefully filled.



ROOFLESS

MONEY-BACK GUARANTEE of Satisfaction



PARTIAL

We take this risk. We guarantee to refund to you your every cent if you're not 100% satisfied after 60 days' trial.

FREE Send for **FREE** impression material, catalog and our new low prices. Send no money—just send name, address.

World's Largest Mail Order Dental Laboratory

UNITED STATES DENTAL COMPANY

1555 Milwaukee Ave., Dept. A-42 Chicago, Ill.

Be an ARTIST!

—Train at Home in Your Spare Time

The fascinating field of Art offers commercial opportunities to men and women. **COMMERCIAL ART, CARTOONING, ILLUSTRATING** all in one complete course. Learn to draw step-by-step. Trained Artists are capable of earning \$30, \$50, \$75 a week. Write for illustrated **FREE BOOK**, "Art for Pleasure and Profit." No obligation. **TWO ART OUT-FITS** furnished.—State age.

WASHINGTON SCHOOL of ART, Studio 1310T
1115—15th St., N. W. WASHINGTON, D. C.

FREE BOOK
gives details

MONEY for MEN ALL FREE

THE PLASTEX Industry needs manufacturers on small scale and for big production of Lamp and Clock Stands, Art Goods and Novelties in Plastex and Marble imitation. Experience unnecessary. 1/2c material makes regular 10c store sellers. Rubber moulds furnished for speed production. Small investment brings good returns. We are now placing big Xmas chain store orders with manufacturers. Ambitious men have chance for real prosperity. Our Free booklet will interest and benefit you.

PLASTEX INDUSTRIES, Dept. 2, 1085 Washington Ave., New York, N.Y.

Become a Doctor of PSYCHOLOGY

Win the degree of Ps.D. Teach the secret of contentment, happiness. Solve mental worries. Experience the revelation of truth. Chartered college. Individual help. Write for **FREE** book. **COLLEGE OF UNIVERSAL TRUTH**, 20-A E. Jackson Blvd., Chicago.



SUCCEED IN AVIATION

Study Aviation at one of America's finest and oldest established Aviation training schools. Modern, fully equipped Airport, Hangars and classrooms. Expert instructors. Government Approved courses. Leadership training in

Master Aviation Mechanics, Aeronautical Engineering. Personalized instruction. New classes now forming. Placement service. Write for descriptive literature.

August G. Becker, Director
P.O. Box 988 Pittsburgh, Pa.

PITTSBURGH INSTITUTE OF AERONAUTICS

YOUR OWN BUSINESS

MAKING CASTINGS FOR US

We need additional full or spare time manufacturers to cast for us Christmas Goods, 5 and 10c Novelties, Ashtrays, Toy Autos, Soldiers, etc. Can be started in any spare room and no experience necessary. An opportunity to be your own boss and make real money. For full information about this interesting and profitable work write:

METAL CAST PRODUCTS CO.
1696 Boston Road

Dept. E.
New York, N. Y.

LEARN WATCH REPAIRING



AT HOME You can learn by our modern and original system of instruction every part of the **Watch Repairing Trade** at home. Prepare yourself for a well paying position or start in business after completing our course of instruction. Good watch repairers are in demand and generally earn very good salaries. For particulars apply to the **Wisconsin School of Watch Repairing** 524 E. Mason St., Dept. P-10, Milwaukee, Wis.



YES! YOU CAN MAKE BIG MONEY WITH HOOVER UNIFORMS!

Make big earnings with famous nationally-advertised Hoover line of smart, exclusive Uniforms for restaurants, fountains, hotels, taverns, stores, offices, doctors, dentists, etc. Not house-to-house. No experience—no money needed. Mail postcard for beautiful new Uniform Style presentation, actual samples and money-making equipment—sent **FREE**. **HOOVER**, 251 W. 19th St., Dept. YK-18, New York.

Please mention POPULAR SCIENCE when writing to advertisers.

PARKS AIR COLLEGE

PARKS AIRPORT EAST ST. LOUIS, ILL.

Offers YOU COLLEGE and PROFESSIONAL TRAINING Majoring in AVIATION

Accredited by the Illinois Superintendent of Public Instruction. Included in the Accredited Higher Institutions 1938, issued by the U. S. Office of Education, Federal Security Agency. U. S. approved as a Commercial Ground and Flying School and Mechanics' School. Accredited by and cooperating with the United States Army Air Corps in giving flight and mechanical training. Open to high school graduates. **FOUR** courses lead to B.S. degrees in Professional Piloting, Aviation Operations, Maintenance Engineering, Aeronautical Engineering.

TWENTY-TWO TRAINING PLANES are used in professional flight training which prepares graduates for airline flight operations. **FACULTY** of 82 specialists in various fields of aviation.

1569 graduates. Enrollment limited to a total of 300 commercial aviation students. Capacity enrollment of 560.

100-acre airport, 25 buildings devoted to school purposes exclusively. Dormitories and dining hall at the College.

Winter term January 5. Send postcard for new 64-page catalog.

15th YEAR PARKS AIR COLLEGE, East St. Louis, Ill.
Registrar, Dept. PS-10

TRI-STATE COLLEGE

B. S. Degree in 2 1/4 Years

World famous for technical 2 1/4-year courses in Civil, Electrical, Mechanical, Chemical, Radio, Aeronautical Engineering; Business Administration and Accounting. Special preparatory

department for those who lack required high school work. Short diploma courses (36 weeks) in Surveying, Drafting. Low tuition. Low living costs. Students from every state and many foreign countries. 58th year. Enter January, March, June, September. Write for catalog. **Burton Handy, Pres., 5101 College Ave., ANGOLA, INDIANA.**

AN AVIATION CAREER

OFFERS YOU GREAT FUTURE!

Demand for trained aircraftmen is increasing and already exceeds supply. Curtiss-Wright Tech, Aviation's foremost school, is located on Grand Central Air Terminal in heart of the aircraft industry and specializes in training **MASTER MECHANICS** and **AERONAUTICAL ENGINEERS**. (No flying involved.) Graduates are obtaining immediate employment. Write for details NOW. Dept. PS-10

Curtiss-Wright Technical Institute, Glendale (Los Angeles) California

DRAFTING

MORE DRAFTSMEN NEEDED in all manufacturing and building lines—\$30 to \$50 a week and UP. Learn quickly at home in spare time. *Selective Employment Service*. Write NOW for FREE Bulletin. No obligation.
American School
Dept. 1DD746, Drexel & 58th, Chicago

RADIO

ENGINEERING, broadcasting, aviation and police radio, servicing, marine and Morse telegraphy taught thoroughly. 48 weeks' engineering course equivalent to three years' college radio work. School established 1874. All expenses low. Catalog free.

Dodge's Institute, Nye St., Valparaiso, Ind.

TRAIN FOR TECHNICAL RADIO WORK. I give you full Radio Equipment including Tester, Radio Tools, 146 Radio Parts. You do over 100 actual experiments. You are pre-conditioned with Radio repair experience right in your own home! **FREE:** Write for complete details in new catalog "HOW TO MAKE MONEY IN RADIO".
SPRAYBERRY ACADEMY OF RADIO, 4557 University Place, N. W., Washington, D. C.

Print Your Own

Cards, stationery, circulars, tags, labels, advertising, etc. Save money. **Print for Others, Big Profits;** easy rules sent. Will do popular Raised Printing like Engraving. Junior outfits \$8.25, Senior outfits \$17 and up. Send for free catalog and all details.
KELSEY, INC., Y-33, Meriden, Conn.

TYPEWRITER 1/3 PRICE

STANDARD OFFICE MODELS
About 1/3 MFRS. ORIG. PRICE
Easiest Terms **70¢ A WEEK**
as Low as

All models completely rebuilt like brand new.
FULL 2-YEAR GUARANTEE
No Money Down—10 Day Trial

FREE COURSE IN TYPING INCLUDED
Send for FREE price smashing literature in colors. Fully describes and shows all models. See our literature before you buy. **SEND TODAY.**

INTERNATIONAL TYPEWRITER EXCH.
Dept. 1007 231 W. Monroe St., Chicago, Ill.



IMPORTANT Message To

INVENTORS

We Will
Send You Our
FREE
BOOK

"HOW TO PROTECT
YOUR INVENTION" and
Invention Record Form

Our laws favor the inventor who makes a dated record of his invention, and who is diligent in filing his patent application.

You owe it to yourself, if you value your invention, to make an accurate, dated, and witnessed record of your invention, and then take steps to apply for a patent just as quickly as possible.

PERSONAL SERVICE

Hence, our service can be important to you: As soon as you write us, we send, by return mail, an "Invention Record" form for you to fill out. And then, when you return it to us, our prompt and personal service begins: We personally direct the search of the Patent Office Records. Personally report to you. Personally supervise the preparation and filing of your application and the handling of your case. There is no lost motion, no lost time.

PATENT AND SELL YOUR INVENTION

We handle your case skillfully and thoroughly with a view to securing the best possible patent for you—giving you the full benefit of our training as patent attorneys and our years of experience serving hundreds of inventors. We make personal calls at the Patent Office when required. And beyond this, we will endeavor to give you useful hints and suggestions on selling your invention.

WRITE US TODAY . . .

When your invention comes to us it is strictly confidential. All correspondence is handled personally by us. We take a personal interest in your success, so you can write us fully.

IMPORTANT TO GET STARTED RIGHT

Know how the laws protect you, and what steps to take. We will send you Complete FREE Booklet "How To Protect Your Invention", and FREE "Invention Record" Form. Write us, or mail this coupon today—McMorrow and Berman, Registered Patent Attorneys, 142-R Barrister Building, Washington, D. C.

MAIL COUPON NOW

McMORROW & BERMAN

REGISTERED PATENT ATTORNEYS BEFORE U.S. PATENT OFFICE

142-R Barrister Building Washington, D. C.

Send me your NEW FREE Book "How to Protect Your Invention" and specially prepared "Invention Record" form at once. I understand that this request does not obligate me.

Name.....

Address.....

City..... State.....

Write or Print Name Clearly

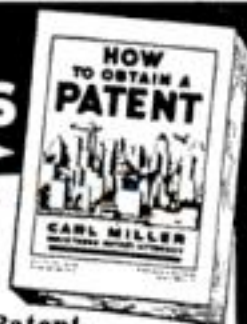
INVENTIONS WANTED PATENTED OR UNPATENTED

Practical and useful new inventions, or novel improvements on previously protected devices, can now be safely marketed without patenting expense. We have successfully helped inventors for over 17 years in selling their unpatented ideas to manufacturers, with positive safeguards under Federal Court decisions. Send for complete information about this co-operatively owned association. Over 50 invention-minded employees to give you efficient, individual service.

References: Dun & Bradstreet, Thomas' Register of American Manufacturers, etc.

CHARTERED INSTITUTE OF AMERICAN INVENTORS
DEPARTMENT 3, BARRISTER BUILDING WASHINGTON, D. C.

INVENTORS PATENT YOUR IDEAS SEND FOR FREE BOOK



HOW TO OBTAIN A PATENT

Written by a Former Member of the Examining Corps (1922-24) of the U. S. Patent Office. If you want to profit by your idea, you should take steps to apply for a U. S. Patent at once. Your first step is to get this Free Book. This interesting illustrated book contains valuable information you should have. It tells you fully how to obtain a patent on your idea in the quickest way. With this Free Book you will also receive a "Record of Invention" form on which you can easily record your idea. Personal and Confidential Service: Your case will be personally handled only by a Registered Patent Attorney who is also a Former Member of the Examining Corps of the U. S. Patent Office. All communications confidential.

MAIL COUPON TODAY for FREE PATENT BOOK and RECORD OF INVENTION Form.

CARL MILLER
REGISTERED PATENT ATTORNEY
FORMER MEMBER EXAMINING CORPS U. S. PATENT OFFICE

Woolworth Bldg., 35th Floor, Dept. 101-C, New York City
MILLER BUILDING, Dept. 101-C, WASHINGTON, D. C.

Please send me your Free Book, "How to Obtain a Patent," and your "Record of Invention" form.

NAME.....

ADDRESS.....

OPPORTUNITY TO EARN \$1040 WHILE LEARNING

Available to Qualified Students Through
Cooperation of Milwaukee Industries

A most unusual offer to High School graduates who must earn tuition and part of living expenses while preparing for career as Aircraft Technician, Draftsman, Electro Technician or Welding Technician. Choose any of these four up-to-the-minute practical courses and train for work in vital defense industries. A few more "In Service" fellowships offered by cooperating Milwaukee manufacturers still available. 3-months courses in Aircraft or Arc Welding also offered. Write now for full details and your copy of "Career Building" without obligation. Mention course desired.



MILWAUKEE SCHOOL OF ENGINEERING
P.S.-1041 N. Broadway & E. State, Milwaukee, Wis.

Learn to MOUNT BIRDS

Tan SKINS, make up FURS
Be a Taxidermist. Double your hunting fun. We teach you at Home. Mount Birds, Animals, Fish, Heads, common specimens. Fun and profits. Decorate home and den **MAKE MONEY**. Mount game, tan for others. Big profits in spare time. **WRITE TODAY.** 100 game pictures in **FREE BOOK**. Hunters, get your copy. It's **Now Free**. Send post card. State your **AGE**.
NORTHWESTERN SCHOOL OF TAXIDERMY
Dept. 3397 Omaha, Nebraska

FREE BOOK

PATENTS PERSONAL SERVICE

My Personal service assures strictest confidence on all your patent problems. Send me a model or drawing, or sketch and description of your invention, and \$5.00. I will make a search and report promptly as to its patentability and send you a copy of my 72-page booklet. Or, if you prefer to read my booklet first, write today for **FREE** copy. Registered Patent Attorney.

L. F. Randolph, 340-D Victor Bldg., Washington, D.C.

RUPTURED?

Get Relief This Proven Way

Why try to worry along with trusses that gouge your flesh—press heavily on hips and spine—enlarge opening—fail to hold rupture? You need the Cluthe. No leg-straps or cutting belts. Automatic adjustable pad holds at real opening—follows every body movement with instant increased support in case of strain. Cannot slip whether at work or play. Light. Waterproof. Can be worn in bath. Send for amazing **FREE** book, "Advice To Ruptured" and details of liberal truthful 60-day trial offer. Also endorsements from grateful users in your neighborhood. Write:
CLUTHE SONS, Dept. 14, Bloomfield, New Jersey.



New Way to Learn to Sing

Here is an amazing new way to perfect your singing voice in your own home. Use this new method based on years of voice training by a famous instructor. Hundreds of teachers, professional singers and those who study music for cultural reasons have paid Dr. Granville large sums for personal instruction. Now you can get this training, his own method, right in your own home with his new system just developed. The price is low and terms are easy. Don't miss this great chance for voice improvement. Radio alone offers good singers thousands of opportunities at big pay. Write for free information today.

GRANVILLE SCHOOL OF VOICE

Dept. 723 100 East Ohio Street Chicago, Illinois



Begin today. Write for our New Free Book, "How to Become a Good Penman," it contains specimens and tells how others learned to write in spare time. Enclose 10c for a Professional Pen Point and your name beautifully written. Write today.

THE TAMBLYN SCHOOL OF PENMANSHIP
439 Ridge Building, Kansas City, Mo.

Big Money for Workers In Home or Shop



EARN MONEY as Licensed Concrete Specialist. Make lawn pottery without molds. Patented method. Cemetery products, novelties, tiles, floors, colorglazing, patching, basement waterproofing. Other projects. Workers wanted everywhere. Booklet, colorplate, details 10c.

NATIONAL POTTERIES COMPANY

Dept. B, 11 W. 26th St. Minneapolis, Minn.

LEARN to WRITE SIGNS & SHOWCARDS

BE THE SIGN AND SHOW CARD MAN IN YOUR TOWN

Have your own business, profitable every month of the year. Everybody needs signs. Start at home. Be your own boss. Interesting, light, pleasant work. Experience unnecessary. The quicker you start, the sooner your profits begin.

New Method of Personalized Instruction

Learn at home, with personal help and suggestions from expert teachers. Start earning after first few weeks. Write today for full information.

MICHIGAN LETTERING & POSTER SCHOOL

2023 W. Grand Blvd. Detroit, Mich.

**FOR FAME AND FUN—PLAY A
PEDLER
CLARINET**



• It's easy. Clarinet players are in popular demand in leading bands and orchestras. Radio success may be yours. But, be sure to get started right—on a Pedler. Opportunities galore to earn extra money, travel and make a name for yourself. Free Trial, easy payments. Send now for **FREE FOLDER.**

THE PEDLER COMPANY
Custombuilt Woodwinds
Dept. P-10, Elkhart, Indiana

ELECTRICAL ENGINEERING IN ONE YEAR

Prepare at Bliss for a better place in vital industries and defense. Learn fundamentals of electrical theory and practice. Apply them in modern shops and laboratories. Competent faculty gives personal supervision. Graduates in demand. Comfortable living quarters; spacious campus. 49th year. Reasonable rate. Catalog. 110 Takoma Ave., Washington, D. C.

BLISS ELECTRICAL SCHOOL

42nd YEAR ENGINEERING DEFENSE COURSES

Short, intensive Defense courses in Aircraft, Sheet Metal, Mechanical, Structural, Architectural Drafting; Electricity; Power Plant; Arc, Aircraft Welding. One and Two-Year courses in Aeronautical, Electrical, Mechanical, Structural, Architectural, Civil Engineering. B.S. Degree 3 Yrs. Low tuition and living costs. Part-time work for room and board. Thousands successful graduates. Extensive equipment. Theory and practice. Non-essentials omitted. No home study courses. Catalog free.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.

NEW WAY TO CHOOSE A CAREER

LET SCIENCE
PICK A JOB
FOR YOU!

TODAY, getting a job or choosing a career is no longer a hit-or-miss task. Science can now accurately determine for you, in advance, just what type of work or profession you are best suited for. Send your name on a penny postcard for **FREE** explaining this new proven way to greater success.

Vocational Guidance Asso., Dept. 210, 305 West 8th St., Los Angeles, Cal.

AVIATION

MORE DRAFTSMEN NEEDED on planes, motors, equipment. Big pay. Special *Aviation Drafting* course trains you **QUICKLY** at home in spare time. **FREE** Bulletin. No obligation. Address
American School, Dept. A-746, Drexel at 58th, Chicago

BRUSH PLATING OUTFITS

for autoparts, reflectors, faucets, bicycles.
No tanks necessary. Free particulars.

GUNMETAL CO., AVE. F, DECATUR, ILLINOIS

Correspondence Courses in **RADIO and ELECTRICAL ENGINEERING** **LOW AS \$25**

ELECTRICAL ENGINEERING. Get good grasp of wide electrical field. Modern. Very understandable. Theory made easy.
RADIO ENGINEERING. Extra fine course in radio, public address, photo-electric work. Trains you to be super-service man, real vacuum tube technician. Tuition **ONLY \$25**, either course. Deferred payment plan. Experiment kits furnished.
FREE Write for free copies of school catalogs, student magazines, etc.
LINCOLN ENGINEERING SCHOOL, Box 931-S-34, Lincoln, Nebr.

See
WOODSTOCK
TYPEWRITER

These Free Books are for INVENTORS

And other men with ideas

SOMETIMES we hear people say: "Well, there isn't much left to invent." But Charles F. Kettering, Vice-Pres. and head of Research of General Motors, who helped develop the self-starter, Duco and many other outstanding inventions, doesn't think that at all. In a published statement, he said:

"If we took half the men employed in tool making and put them to working out new inventions, new things, we could snap out of this depression in no time. Our return to normal times depends on new manufactured products that will catch the purchaser's eye. Get him to buy and thus start the ball rolling. Change and buying go together. We are only entering the great period of inventive advancement."

Our Business is to Help You

For forty-three years, this organization has been in the business of helping inventors. During that time inventions from every corner of the country have been turned over to us to protect. Some ideas have represented complicated mechanisms; others have been small, practical articles, like a can opener or a new toy. All this has given us a wealth of experience to use for the inventor of today. Here in Washington, we maintain a large staff of experienced Patent Specialists to give you prompt and expert service. Yet because we work efficiently—our fees are low, and if desired we help you with deferred payments. But first, find out exactly what to do to protect yourself. Decide on that today by sending for your **FREE** copies of the books shown here.

THESE BOOKS TELL YOU:

How the Patent Laws protect an inventor. Simple steps to take promptly, without cost, to claim your right to your idea. Kind of sketch or model needed. How you go about selling an invention. We gladly send them to serious men. No charge, no obligation. Write us or use the coupon below. Get that much done today.



VICTOR J. EVANS & Co.

Merlin M. Evans
REGISTERED PATENT ATTORNEYS

**MAIN OFFICE: 430-L VICTOR BUILDING
WASHINGTON, D. C.**

**Pittsburgh Office: 521-C Empire Building
Los Angeles Office: 738-C Security Bldg.**

Send me free copies of your books, "Patent Protection" and "When and How to Sell an Invention"—also important "Evidence of Invention" form.

Name
Street and No.
City or Town State

Please mention POPULAR SCIENCE when writing to advertisers.

MAIL COUPON TODAY FOR YOUR COPIES

THOUSANDS ENJOY THRILL OF PLAYING Who Didn't Know a Note of Music



Over 700,000 people have studied music at home this easy way. See how quickly you can learn without a private teacher, without needless study and practice. This wonderful print and picture method shows you just what to do, makes every move clear. It starts you learning real tunes by note in first few lessons—you learn to play by playing!

Costs Only Few Cents A Day

Best of all, the cost is surprisingly low—averaging only a few cents a day—for whatever instrument you choose. If you would sincerely like to play a musical instrument, if you want to enjoy the pleasure and popularity that music offers, fill out and mail coupon at once for

illustrated booklet and free print and picture sample. Instruments supplied when needed, cash or credit. U. S. School of Music, 810 Brunswick Bldg., New York, N. Y. (Forty-third Year—Est. 1898).

U. S. School of Music, 810 Brunswick Bldg., New York, N. Y.

I am interested in music study, particularly in the instrument checked below. Please send me your free illustrated booklet and free print and picture sample.

<input type="checkbox"/> Piano	<input type="checkbox"/> Accordion	<input type="checkbox"/> Trumpet	<input type="checkbox"/> Banjo
<input type="checkbox"/> Violin	<input type="checkbox"/> Saxophone	<input type="checkbox"/> Trombone	<input type="checkbox"/> Ukulele
<input type="checkbox"/> Guitar	<input type="checkbox"/> Mandolin	<input type="checkbox"/> Other Instrument	

Name.....

Street.....

City.....State.....



TRAIN FOR ELECTRICITY

I'LL FINANCE YOUR TRAINING
All practical work on real electrical machinery and equipment. No advanced education or experience needed. Lifetime employment help after graduation.

Get training first, then pay tuition later. Write for all details of my "Pay-Tuition-After-Graduation" plan and how many earn while learning. H. C. Lewis, Pres., Coyne Electrical School, Dept. 71-73, 500 S. Paulina St., Chicago.

**LEARN BY DOING
12 WEEKS
TRAINING**

H. C. LEWIS, President, COYNE ELECTRICAL SCHOOL
500 S. Paulina St., Dept. 71-73, Chicago, Ill.

Send Big Free Book with facts on Coyne training and tell me about your "Pay-Tuition-After-Graduation" Plan.

NAME.....

ADDRESS.....

CITY.....STATE.....



Learn Profitable Profession in 90 days at Home

Earnings of Men and Women in the fascinating profession of Swedish Massage run as high as \$40 to \$70 per week but many prefer to open their own offices. Large incomes from Doctors, hospitals, sanitariums and private patients come to those who qualify through our training. Reducing alone offers rich rewards for specialists. Write for Anatomy Charts and booklet—They're FREE.

The College of Swedish Massage
30 E. Adams St., Dpt. 770, Chicago



THERE IS NO EMERGENCY

for those who have a true and stable philosophy of life. An invulnerable defense originates in a mind impervious to error. Are you invulnerable? If not, are you doing anything to achieve invincibility? Read LEMURIA THE INCOMPARABLE. 60 pages of evidence supporting the existence of a New Race and Order. TWO DIMES cover the mailing cost. No obligation. Send request today to Dept. 47.

828 N. PLANKINTON AVE. LEMURIAN FELLOWSHIP MILWAUKEE, WISCONSIN

Practical Facts You Will Want to Know About

PATENTS TRADE MARKS COPYRIGHTS

INVENTORS!

This old-established firm assures prompt, confidential advice concerning patent procedure based on 66 years experience in serving thousands of people. You can save time and money now by sending for our free booklets. They explain steps necessary to obtain a patent and opportunities for capitalizing on your idea. All inquiries confidential and answered immediately. Write for free books right now.

• C. A. SNOW & CO.

Registered Patent Attorneys Since 1875

2110 Snow Building Washington, D. C.

INVENTORS! ★

Many a patent application has been rejected by the U. S. Patent Office as unpractical & unworkable. Before applying for patent, why not consult with our staff of expert machine designers? We can save you time & money. A small fee develops your invention into a commercial practical idea. **NATIONAL DESIGNING & DRAFTING CO.**
1 East 42nd St., New York, N. Y. © 1941

INVENT-O-GUIDE

A personal service for inventors

Have you problems in sales and the protection of inventions? Are you working in paying fields? Can your protection costs be reduced? Write for information.

INVENT-O-GUIDE, Box 175 Grand Central Annex, New York, N. Y.



FREE CATALOG - PINS and RINGS

Class pins, club pins, rings and emblems. Finest quality. Reasonable prices from 30c up. Write today for our attractive, free catalog.

Dept. 6, METAL ARTS CO., Inc., Rochester, N. Y.

DO YOU OWN A RAILROAD?

Here at last is a new and complete handbook for the Model Railway enthusiast. Shows you how to save real money building and laying your own track, making an automatic signal system, constructing bridges, culverts, tunnels, stations, semaphores, water tanks, coaling trestles, roundhouses, turntables, crossing gates, switches, etc. The detailed instructions and diagrams in this great book make it easy.

EVERY MODEL RAILWAY ENTHUSIAST NEEDS THIS NEW BOOK

Tells you how to utilize every bit of available space in laying out your system. How to turn out smoke stacks, fire boxes, boilers, and wheels, in your own shop. Complete, easy-to-follow instructions for building a box car, gondola, refrigerator, tank, hopper, caboose, day coach, pullman, baggage, and observation car. Complete plans, specification, instructions, and scale blueprint for building the popular Atlantic type locomotive.

Send only \$2.00 for your copy of Model Railways or we will ship C. O. D. plus a few cents postage. Satisfaction guaranteed or money back. Address

Popular Science Monthly, Dept. 101
353 Fourth Ave. New York, N. Y.

FALSE TEETH

LOW
AS
\$6.85

90 DAYS' TRIAL

TEST THEM

EXAMINE THEM

We make FALSE TEETH for you by mail from your own impressions. You have satisfaction of MONEY-BACK GUARANTEE. Customers report satisfaction but you be your own judge.

SEND NO MONEY WRITE TODAY for FREE Booklet and Material.

CLEVELAND DENTAL SUPPLY COMPANY
Dept. 33-P1, East St. Louis, Illinois



1000% to 1500% PROFIT—GET IN ON BIG CASH EARNINGS

Is not unusual in the COMPOSITION NOVELTY MANUFACTURING BUSINESS and—it costs you very little to get started. Stewart's Studio has started thousands in this profitable business and daily we receive letters telling us of the big profits they are making.

No Experience Required—It's Easy—Actually Fun!

Stewart's complete illustrated instructions fully explain every step in simplified detail—tells you how to make genuine flexible, long-life rubber molds—how to cast and finish beautiful, fast-selling novelties of plaster, liquid marble, plastic, cement, etc. Just select models you like and order these kits or if you wish order the complete rubber molds so you can start production immediately. Stewart's liquid rubber and rubber molds are regularly used by many of the largest manufacturers in this country. You can, therefore, place your order with the full confidence you are getting the finest materials that money can buy.



No. 1. 4 1/2"x4" No. 2. 4 1/2"x3 1/4"



No. 3. 3"x3" No. 4. 3"x3"

Kit consists of model 1, 2, 3 or 4, Stewart's Rub-er-Spra for making rubber mold and complete illustrated instructions. Specify model wanted. Kit only \$1.25 ea. SET OF 4 KITS... only \$3.75

\$1.25 ea.

SPECIAL OFFER

Completed genuine rubber mold—READY FOR USE—of any of the above models only \$2.50. Set of 4 molds only \$7.95.

BIG DEMAND For Novelties

Importation of novelties from other countries is at practically a standstill now. This condition has developed a tremendous shortage and many customers report they are weeks and even months behind on orders. It's a break for you—get started now and cash in on some of this profitable business.

NEW IMPROVED Rub-Er-Spra

Better than ever—still by far the world's finest mold-making material. It's economical to use the best. Quart only \$2.95. Gallon complete with spray gun and fully illustrated instructions only \$6.95.



\$6.95



No. 5. 5 1/2"x6 1/2"



No. 6. 5 1/2"x7"



No. 7. 13 1/2"x3 1/2"



No. 8. 6"x5"

COMPLETE KIT ONLY \$3.95 ea.



Kit consists of model 5, 6, 7 or 8, Stewart's Rub-er-Spra for making rubber mold, Rub-er-Spra gun and complete illustrated instructions. Be sure to specify model wanted. SET OF 4 KITS... only \$9.95.

SPECIAL OFFER

Completed genuine rubber mold—READY FOR USE—of any of the above models only \$7.95. Set of 4 molds only \$24.95.

ORDER SEVERAL KITS OR MOLDS AND TAKE ADVANTAGE OF THE BIG CASH SAVINGS



No. 9. 13"x4"



No. 10. 11"x8"



No. 11. 11"x7"



No. 12. 11"x8"



No. 13. 13"x4"

Kit consists of model 9, 10, 11, 12 or 13, Stewart's Rub-er-Spra for making rubber mold, Rub-er-Spra gun and complete illustrated instructions. Be sure to specify model wanted. SET OF 5 KITS... only \$19.75.

Completed genuine rubber mold—READY FOR USE—of any of the above models only \$12.95. Set of 5 molds only \$49.95.

STEWART'S STUDIO, DEPT. PS-10, 1008 GEORGE ST., LAKE GENEVA, WIS.

MAIL YOUR ORDER TODAY—

Special Prices on Other Materials

- Extremely hard molding composition. Mixes with water, dries so hard sandpaper won't cut it. 100 lbs... \$2.43
- Finest quality lustrous pearl essence lacquer, 8 oz.95
- Lacquer tinting colors (any color), 1 oz.25
- White brushing lacquer. Per qt. 1.23
- Clear lacquer. Per qt.93
- White shellac. Per qt.93
- Artist's paints (any color). Per tube.24
- Permanent modeling clay. Per lb.25
- Staples and rings for hanging plaques. Per gross47

ALL PRICES F. O. B. LAKE GENEVA, WIS. Subject to Change Without Notice

FREE!

LIMITED OFFER

Mail Coupon for our Big Illustrated Book explaining secrets of rubber mold making and novelty casting. Tells you how to make BIG PROFITS. ..

SUPPLY LIMITED! Mail Coupon Today

Stewart's Studio, Dept. PS-10 1008 George St., Lake Geneva, Wis.

RUSH ORDER

Please send me the following items at special prices quoted in your ad.

- ☐ Check or M. O. ☐ 50% deposit herewith. I'll pay balance C.O.D.
- ☐ Send FREE BOOK on mold making.

Name.....

Address.....

City..... State.....

**Increased
production
means more**



Jobs for MACHINISTS

and bigger pay for men who know their work

This home-study course gives you the practical facts on modern machines, up-to-date methods, you need to advance in machine shop work. Take advantage of the other man's experience as found in books, to solve your problems, increase your efficiency, with

The AMERICAN MACHINISTS' LIBRARY

6 volumes—2368 pages—2516 illustrations
(A combined home-study course and reference library)

This library of machine shop practice was written for practical men. It gives you the best methods for every kind of machine shop work. It fully explains lathes, drills, and other machine tools and their operation, automatic screw machines, speeds and feeds, gear design and production, jigs and fixtures, punch and die work, metal surfacing, etc., etc. Plainly written—completely illustrated—the best kind of help to the machine shop man who wants to advance himself.

No money down—special price—easy payments.

EXAMINATION COUPON

McGRAW-HILL BOOK CO., 330 W. 42nd St., New York

Send me for ten days' examination the American Machinists' Library. If satisfactory I will send you \$1.50 in 10 days and \$3.00 monthly until the price of \$19.50 is paid. If not wanted, I will return the books postpaid. (To insure prompt shipment write plainly and fill in all lines.)

Name.....
Home Address.....
City and State.....
Position.....
Name of Company..... PSM-10-41

**GET IN AND
Live!**



SCHULT—last word in a real home on wheels—offers roomy, attractive living quarters with every convenience. No matter where you go (or stay), you can live in comfort. Completely furnished, no high rents to pay. And a Schult cuts travel costs to the bone.

SCHULT LEADS THEM ALL

Feature-for-feature—in design, construction, fixtures and finish—a Schult is TOPS in "class" and value. See them at your dealer's, or write SCHULT TRAILERS, INC., Dept. 3110, Elkhart, Indiana.

Write
FOR FREE
CATALOG

SCHULT
TRAILERS

EASIEST to MASTER
A NEW
BUESCHER
True Tone



JUST OUT—new—radically improved Buescher Saxophone that enables you to master tunes easier than ever; qualify for band in a very short time. Then popularity plus friends; good times; and extra money. NO instrument equals Buescher for quick results. FREE Home Trial, easy payments, any instrument, sax, trumpet, trombone. Write today.

BUESCHER BAND INSTRUMENT CO.
Dept. 1013 - - - ELKHART, INDIANA

Like many
Famous Band Leaders
Bernie Cummins features
an all Buescher
Sax Section

FREE Beautiful 32 Page
Magazine on Music. Send
Card—Mention Instrument
That Interests You

**LEARN A
PROFESSION
INSTEAD OF A TRADE**

**BE A
DRAFTSMAN**

Just a half hour a day of spare time at home can fit you for a good drafting position, where the pay is big and opportunities for advancement are many. Hundreds of foremen, superintendents and general managers started on the drafting board. Get into this interesting, money-making profession RIGHT NOW while millions of dollars are being spent in public works and plans must be drawn before the work can start. Write for FREE bulletin on how to become a draftsman, in spare time, at home. American School, Dept. 2DD746, Drexel at 58th, Chicago

MAKE MONEY AT HOME

**RUBBER
MOLDS** Low as
6¢ EA.

Amazing rubber mold-making outfit makes perfect flexible molds of plaques, ash trays, book-ends, etc. Molds cost from 6c to 25c each. Each mold makes hundreds of novelties and gifts to sell up to \$1.00 apiece! No experience necessary. Quick and easy. Start profitable business in your home... sell to stores, gift shops, friends, resorts, road stands, by mail. Full or spare time. "Molders Handy Book" and list of buyers FREE. Write

SO-LO WORKS
Dept. B-823 Cincinnati, Ohio



**NEW! MINIATURE
DUST MASK**

Wear DUPOR No. 1 when sanding, grinding, paint spraying, sweeping, dusting, furnace cleaning, etc. Handy as a pair of glasses. Just keep mouth closed and breathe through nose is all you do to operate. Protects against nuisance dusts, lint, coal, cement, grain dust. Weighs 1 oz. Has 9 sq. in. filter. Book on DUPOR Respirators sent FREE.

H. S. COVER, Dept. PS, South Bend, Ind.
PIONEER RESPIRATOR DESIGNER SINCE 1894



**BIG MONEY BUILDING MEAD'S
New Portable OUTBOARD
BOAT**

IN A FEW DAYS AT HOME!

Build this light 50 lb. tough, durable, seaworthy portable Outboard Ki-Yak! Take it anywhere by hand or car. Safe, dependable, troublefree. More speed per horsepower, more miles per gallon. MEAD'S perfected metal-ribbed, cut-to-fit construction Kit guarantees successful assembly, quickly, easily, economically. New 69 lb. OK-4 uses oars, sail, motors, 9 h. p. or less. Also 3 "CK" paddle-sail models from 20 lbs. to 45 lbs. Double Paddle or Oars INCLUDED with your Ki-Yak! Write for FREE lavishly-illustrated circulars, low Factory-To-You Prices!

MEAD GLIDERS, 15 S. Market St., Dept. D-101
Chicago, U. S. A.

PSORIASIS

PSORIASIS Sufferers: Pixacol has brought results when everything else failed. Applied externally, dries quickly, convenient. Try regular \$1 bottle without investing a cent! PIXACOL CO., Dept. P-1, Box 3583, Cleveland, Ohio

CAR OWNERS WE HAVE IT A United States Patent SAVES UP TO 25% ON GAS



FOR ALL CARS
Trucks, Tractors
and Airplanes
Easily installed in
5 minutes. No ad-
justments.

Or, We Pay You a Bonus
Investigate this mysterious gasoline saver that car owners are going wild about. Users report savings unbelievable, aids in removing carbon, reduces spark plug trouble, increases engine speed, saves up to 25% on gasoline bills.
BUILT ON SUPER-CHARGE PRINCIPLE
automatic, self-regulating—has no springs or delicate parts to get out of order—will last a life-time.

DISTRIBUTORS WANTED
Big Profits. Write today for unusual money making offer to handle this remarkable device. Pleasant work—be your own boss.

WRITE FOR SAMPLE OFFER
We will let you try it on your own car for thirty days—so write today.

J. A. STRANSKY MFG. CO. 761-M, PUKWANA, SO. DAK.

LEARN WELDING

Both Electric Arc and Acetylene by practical Shop-Plan method in a few short weeks. No text-books. You learn by doing. Finest equipment. Low tuition. Pay-After-Graduation-Plan. Also, courses in Auto Mechanics, Collision Work, Metal Finishing, etc. Illustrated literature free. Write today.

MICHIGAN TRADE SCHOOL
3718 Woodward, Detroit, Mich. **FREE 32 PAGE CATALOG**

ITALIAN ACCORDIONS

HAND MADE. Very best. Lowest prices. Direct from Factory Representative. Send your name and address for FREE catalog.
ITALIAN & SOPRANI ACC. CO.
323 W. POLK ST., DEPT. PS, CHICAGO, ILL.

THINK

The Thinking Alphabet is a tested short-cut to a keener mind, better speech, stronger personality, quicker advancement, higher earnings.
FREE Mind Power test and Booklet.
Self Advancement Institute, 99A Fern St., Philadelphia.



Thomas E. Lattin
President

I WANT TO TRAIN YOU For A Big-Paying Job IN THE MEAT BUSINESS

I have trained hundreds of men like you to become expert Meat Cutters. Good pay. Steady jobs everywhere. Government figures show over 50,000 new meat markets. My school offers you quick, short, intensive training. Actual practice in big cutting rooms and retail department. Union card FREE. Pay after graduation. Valuable employment service. Write me today for my big FREE catalog and all details.

National School of Meat Cutting, Inc., Dept. O-7, Toledo, Ohio.

5¢ EACH LITTLE BLUE BOOKS

Send postcard for our free catalogue. Thousands of bargains. Address:
HALDEMAN-JULIUS CO., Catalogue
Dept. Desk M-543, GIRARD, KANSAS.

IT'S EASY TO MAKE BIG SPARE TIME MONEY

Send for our free plan on how to make \$5.00 to \$15.00 a week in your spare time by taking orders for the NEW POPULAR SCIENCE MONTHLY from your friends. No selling required. Turn extra hours into extra dollars.

POPULAR SCIENCE MONTHLY
353 Fourth Ave. Dept. 101 New York, N. Y.

THOUGHTS HAVE WINGS

YOU CAN influence others with your thinking! Learn to impress others favorably—get across your ideas. Let the Rosicrucians show you how to use the power of mind. For free book write Scribe DQG.
The ROSICRUCIANS (AMORC)
San Jose, California



"It is the BEST Handy-Sized Dictionary!"

ACTUAL use proves that WEBSTER'S COLLEGIATE defines all the most commonly used words—**IS the BEST.** 1,300 pages; 110,000 entries; 1,800 pictures. \$3.50 to \$8.50 depending on bindings. Buy of your dealer or direct from publishers. Mail coupon for FREE Quiz and Picture Game. G. & C. Merriam Company, 794 Federal Street, Springfield, Massachusetts.



G. & C. Merriam Co., 794 Federal St., Springfield, Mass.
Please send me FREE Quiz and Picture Game, also full information about Webster's Collegiate Dictionary, Fifth Edition.
Name
Address

WANT A GOVERNMENT JOB?



**START
\$1260 to
\$2100 Year**

**Prepare Now For
Examinations**

Thousands appointments yearly

- Railway Postal Clerks
- City Mail Carriers
- City Postoffice Clerks
- Ass't Statistical Clerks
- Stenographers—Typists
- Messengers
- Etc.

**FRANKLIN
INSTITUTE**
Dept. B246
Rochester, N. Y.

32 Page Civil
Service Book
FREE

Rush to me, entirely free of charge, 32 page book with: (1) A full description of U. S. Government jobs; (2) A list of U. S. Government Jobs; (3) Tell me how to qualify for a job.

Mail
Coupon
today—
SURE

Name



"JUST FISHING"

The "BIGGEST" Book for Sportsmen
Ever Published at \$5.00
NOW REDUCED TO—

\$1.95



418 PAGES
3 BIG SECTIONS
15 COMPLETE CHAPTERS
17 FULL-PAGE PLATES
80 FLIES AND LURES
IN FULL COLORS

A BOOK PACK-JAMMED WITH INFORMATION ABOUT EVERY KIND OF FISHING

THE MOST AUTHENTIC COLOR-PLATES EVER INCLUDED IN ANY FISHING BOOK

Every one a masterpiece of modern printing! Full color pictures of small and large-mouthed black bass, native or brook trout, brown trout, rainbow trout, pickerel, pike, muskellunge, wall-eyed pike, land-locked salmon and lake trout. Plus 133 additional illustrations of flies, lures, plugs and baits of every variety.

Why this 61% reduction in price is possible

Our editors long felt that "JUST FISHING" deserved a larger readership than it could ever obtain by \$5.00 bookstore sales alone. So we prevailed upon Mr. Bergman to permit the publication of this special \$1.95 edition especially for our own readers. This low price is possible only because of our vast purchasing power in the paper market and Mr. Bergman's cooperation in accepting a fraction of his usual royalty on this special edition.

We expect the limited number of books still on hand to sell out quickly at this special \$1.95 price. So to be sure of your copy mail the coupon now. "JUST FISHING" is guaranteed to please or money refunded.

Think of it—a book never before sold for less than \$5.00 now reprinted especially for POPULAR SCIENCE and OUTDOOR LIFE readers at \$1.95! The most complete book for fishermen ever published! Every page packed with the kind of practical information that will quickly improve your skill with rod and reel. "JUST FISHING" tells you how to select the best places to fish—how to cast and where—all about live baits, wet and dry flies, plugs, fly-rod lures, tackle, weather.

All Eastern game fish and how to get them are fully described—with full color illustrations galore. At \$1.95 "JUST FISHING" is a bargain that may never be offered again. Mail the coupon below today and see for yourself what a classic among fishing books "JUST FISHING" really is.

For more than 30 years Ray Bergman has been studying fish and their habits. In "JUST FISHING," Bergman gives YOU the benefit of his long experience in outwitting every kind of fresh water fish.

Whether you fish in lake, stream or river—whether you fish for bass, trout, pike, pickerel, land-locked salmon, muskellunge, or any other variety of fresh water fish, "JUST FISHING" tells you *how* and *where* to get them. It's a book you'll treasure for years to come. SEND NO MONEY NOW! Just mail the coupon.

MAIL THIS COUPON TODAY

POPULAR SCIENCE, Dept. 101
353 Fourth Avenue, New York

Please send my copy of Ray Bergman's 418 page book "JUST FISHING." I will pay the postman only \$1.95 plus a few cents postage in full payment. I understand this book is identical in quality and contents with the \$5.00 bookstore edition. If for any reason I am dissatisfied I will return the book in 10 days and you will refund my money in full.

NAME.....

ADDRESS.....

CITY.....STATE.....

If you prefer to send \$1.95 now, we pay postage.

NEW IMPROVED CONNQUEROR



Easy TO PLAY

● World's largest manufacturer announces sensational improvement in Band Instruments. New patented VOCABELL revolutionizes tone effects. Easier to play. You'll develop talent fast with these new Conns. Choice of world's greatest artists. See your dealer or write today for FREE BOOK and home trial, easy payment offer. Please mention instrument.

C. G. CONN, Ltd., 1032 CONN BLDG. Elkhart, Indiana

Write FOR NEW FREE BOOK

CONN
BAND INSTRUMENTS

FOR YOU - A New Day Dawns...

● There is a life-science, a science of projective thinking, a science of mental attunement and idea receptivity. These are the key to success and attainment in all other sciences, the arts, trades and professions. Knowledge of itself is not power. How to use it successfully is Life Science. You can be successful, happy and radiantly healthy. No mysticism or hokum. Seeming miracles without number are reported, but it is all perfectly natural, truly scientific. These instructions are never sold. Others have received them, attained health, happiness and success, and have given and do give that others worthy may receive them, as you will doubtless do, if accepted, when you attain your cherished aims. Without obligation, write and ask for Life Science information and a new day will dawn for you.

B

The ORDER of the ESSENES
2525 SUNSET DRIVE • TAMPA, FLORIDA

New York Electrical School
Established 1902
Ask for free illustrated booklet
40 West 17th St., N. Y. C.

BE OUR REPRESENTATIVE IN YOUR TERRITORY

If you can spare an hour a day you can earn extra dollars taking care of Popular Science Monthly new and renewal subscriptions in your locality. Complete instructions and supplies will be sent free. Send your name and address to

EUGENE WATSON, Popular Science Monthly, Dept. 101
353 Fourth Ave. New York, N. Y.

Learn To **MOUNT BIRDS**

Tan SKINS, Make Up FURS

Be a Taxidermist. Double your hunting fun. We teach you at Home. Mount Birds, Animals, Pets, Heads and Fish. Save your hunting trophies; decorate home and den. **MAKE MONEY.** Mount and Krome-tan for others. Big sparetime profits. **INVESTIGATE TODAY.**

FREE BOOK with 100 game pictures. 48 pages. Hunters, get yours! It's Now Free. Send postal card TODAY -- This Minute! State your AGE.

NORTHWESTERN SCHOOL OF TAXIDERMY: Dept. 3397, Omaha, Nebr.



AUDELS NEW MACHINISTS HANDYBOOK NOW READY!



Prepare!

A KEY TO SHOP PRACTICE
For Every Machinist, Tool-maker, Machine Operator, Draughtsman, Metal Worker, Mechanic or Student. Covers Shop Practice in All Branches.

A READY REFERENCE
Tells How to Operate and Set Up Lathes, Screw and Milling Machines, Shapers, Drill Presses and All Machine Tools.

5 PRACTICAL BOOKS IN ONE!
60 FULLY ILLUSTRATED CHAPTERS Covering: 1—Modern Machine Shop Practice. 2—Blue Print Reading and How to Draw. 3—Calculations & Mathematics for Machinists. 4—Shop Physics. 5—How to Use Slide Rule.

Get This Information for Yourself. Mail Coupon Today. No Obligation Unless Satisfied. **ASK TO SEE IT.**

1600 PAGES FULLY ILLUSTRATED \$4 COMPLETE • PAY ONLY \$1 MO.

THEO. AUDEL & CO., 49 WEST 23rd STREET, NEW YORK
Mail AUDELS MACHINISTS & TOOLMAKERS HANDY BOOK. Price \$4 on 7 Days Free Trial. If O. K. I will remit \$1 in 7 days and \$1 monthly until \$4 is paid. Otherwise I will return it.

Name _____
Address _____
Occupation _____
Reference _____ PSM

MECHANICS

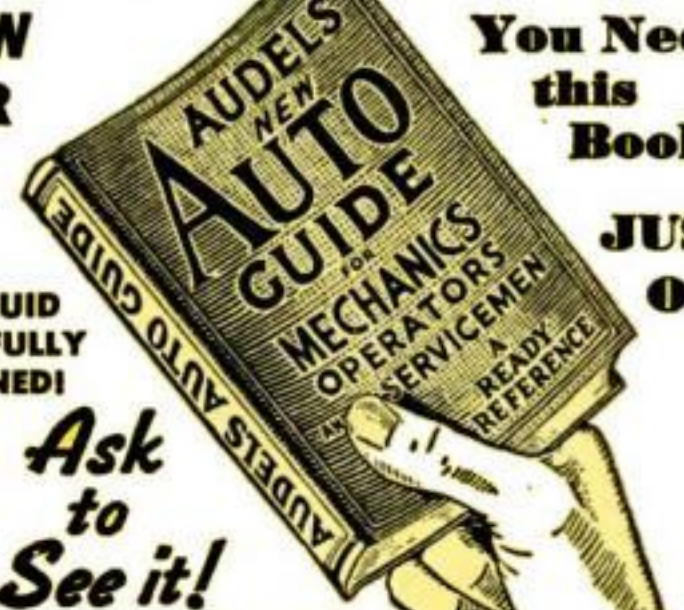
KNOW YOUR CAR

You Need this Book

JUST OUT!

NEW FLUID DRIVE FULLY EXPLAINED!

Ask to See it!



Every operator and mechanic needs **AUDELS NEW AUTO GUIDE**. This book saves time, money and worry. Highly endorsed. It presents the whole subject of auto mechanics: 1—Basic principles. 2—Construction. 3—Operation. 4—Service. 5—Repair. Easily understood. Over 1500 pages—1540 illustrations showing inside views of modern cars, trucks and buses with instructions for all service jobs. Diesel Engines fully treated. \$4 fully illustrated. To Get This Assistance for Yourself Simply Fill in and Mail Coupon Today.

4 COMPLETE • PAY ONLY \$1. A MONTH

THEO. AUDEL & CO., 49 WEST 23rd STREET, NEW YORK
Please send me postpaid AUDELS NEW AUTOMOBILE GUIDE (\$4) for free examination. If I decide to keep it, I will send you \$1 within 7 days; then remit \$1 monthly until purchase price of \$4 is paid. Otherwise, I will return it to you promptly.

Name _____
Address _____
Occupation _____
Reference _____ PSM

New ALL STEEL TOP-1942 CROSLEY CAR!



MEETS TODAY'S
*Defense
Economy
Demands!*

These are the times for driving a Crosley. Despite general price rises, the first cost and operating upkeep of the Crosley Car are lowest in auto history—well within the most modest budget. Imagine equalling the mileage of Cannon Ball Baker, and getting 50 miles to the gallon easily, when he drove his Crosley from coast to coast and half way back again. Covered 6,517.3 miles. Used 129 1/4 gallons of gas; averaged 50.40 miles. Touring operating costs approximate that of long distance phone call. With this amazing economy and with a gasoline shortage and curtailment, it's patriotic to drive a Crosley!

NOW GREATLY IMPROVED FOR '42

After two years of constant testing and improving, the Crosley Car is perfected and completely modernized. Has sure and positive starting; greater acceleration; better hill climbing ability; motor is sturdier, more rugged. And now the brand new, all-steel top, two-door, four-passenger sedan with all safety glass is added to the line, which includes convertibles, station wagon, panel, pick-up and parkway delivery models.

DRIVER AGENTS Write

If we have no dealer in your territory, write for special driver agency proposition.

Prices Start \$325 F. O. B. Factory

DISTRIBUTORS and DEALERS WANTED

Auto dealers facing a car shortage are augmenting sales and maintaining organizations by adding the Crosley line. Write for offer.

THE CROSLEY CORPORATION
DEPT. 955, CINCINNATI, OHIO

Listen
to this
Record!



SPEAK SPANISH

FRENCH, GERMAN OR ITALIAN

"Learn by listening" to Cortina records, the NATURAL way—quickly, easily, cheaply.

Sent on 5 Days' Approval

Most fascinating, most satisfactory method ever known for learning or perfecting yourself in a foreign language. Investigate!

Booklet **FREE**

"The Cortinaphone Short-Cut"—tells just what you want to know. Interesting. Get it!

Write Today--NOW

CORTINA Academy (Language Specialists for 50 Yrs.)
Suite 1210, 105 West 40th St., New York City

Please send me—without obligation—your free booklet. I am interested in (mark):

☐ Spanish ☐ French ☐ Italian ☐ German

Name

Address



EVER BUILT A RADIO?

It's fun — and easy, too, with Lafayette's big new radio and parts catalog! Here's everything you need — America's greatest line of nationally advertised parts, equipment, ham gear, tools, instruction books — all standout values at Lafayette's rock-bottom money-saving prices. Start that radio now. Send for your FREE Lafayette catalog TODAY! Penny post card will do.

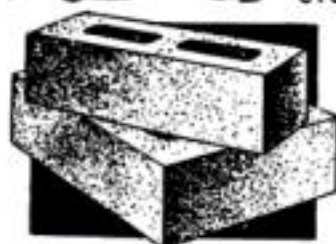
901 W. JACKSON BLVD., CHICAGO, ILL.

LAFAYETTE RADIO Dept. 9K1, or 100 SIXTH AVENUE, NEW YORK, N. Y.

Gear YOUR Business to ESSENTIAL WORK



Priorities, shortages and increasing costs are forcing adjustments in every line of work and business. Particularly in the building industry, where lumber and steel are hard to get, even at soaring prices.



You can capitalize on these conditions by supplying the trade with Brikcrete—the new scientific masonry unit. Better than brick, yet brings wall costs down to frame prices. Fireproof, termite-proof, permanent. Has beauty of color and streamlining, strength and self-contained insulation.

No Priorities • No Scarcities

Brikcrete is made from materials and labor that will always be plentiful and low priced. Unlimited market possibilities—now and in the future. We supply complete plant equipment for local manufacturing in protected territories. Requires but modest investment. Profits up to 150%. Write immediately for The Brikcrete Book—free.

BRIKCRETE ASSOCIATES, INC.

4675 Division Avenue, S. Michigan
Grand Rapids,

BRIKCRETE



Ship Model Tricks of Experts

NOW MADE EASY FOR AMATEURS

Now you can easily make a beautiful to-scale model of a gorgeous four masted galleon, trim racing yacht, or fast ocean liner from the simple plans fully explained with working diagrams in this brand new manual. Join the fast growing group of those who are turning to ship models for their favorite hobby. It's a fascinating way of spending leisure time and a finished model will get many approving looks and words of praise from your friends.

MANUAL OF SHIP MODEL MAKING tells you how to make any model. Step-by-step instructions that will help you select and make your tools, shape your hulls, build your deck fittings, and apply your rigging and sails. All about small parts—deck houses, stanchions, steering wheels, pumps, ladders, spars, yard and mast fittings, deadeyes, blocks, fretwork, finishing, decorating, etc. Trick methods, short cuts, kinks, and time-saving methods of experts. Almost 100 illustrations. Full cloth bound. Sent for \$1.00 C. O. D. plus a few cents postage. Write for MANUAL OF SHIP MODEL MAKING.

POPULAR SCIENCE MONTHLY, Dept. 101
353 Fourth Ave., New York, N. Y.



Wonders Through The MICROSCOPE

A new book which tells you all about MICROSCOPY. Turn an inexpensive microscope on hundreds of specimens within a stone's throw of your front door and you step off into a new world of wonders. Complete Manual for amateurs. How to use equipment, secure and preserve specimens, take photomicrographs, etc. Numerous illustrations. Full cloth bound \$1.00.

POPULAR SCIENCE MONTHLY, Dept. 101A
353 Fourth Ave. New York, N. Y.

POPULAR SCIENCE



Classified

OPPORTUNITIES

**MONEY-MAKING,
MONEY-SAVING**

Classified Ads only 35c per word per insertion, payable in advance. Minimum ad 10 words. To be included in November issue copy should be in our office by September 9th. November issue on sale October 1. POPULAR SCIENCE MONTHLY—351 FOURTH AVE.—NEW YORK CITY

ADHESIVES

MYTEE-BOND—The Miracle Adhesive—Request booklet. Handy size 30c. Slo-mon's Laboratories, Long Island City, N.Y.

ADVERTISING

MAIL-ORDER or agent ad reaching 1,000,000 families throughout United States \$14.00 inch. Newspaper, magazine, mailing-list, ratebook, free. Chicago Advertising Agency, 20-SP West Jackson, Chicago.

LEARN Advertising at home. Easy practical plan. No text books. Common school education sufficient. Interesting booklet and requirements free. Page-Davis School of Advertising, 1315 Michigan, Dept. 1741, Chicago.

ADVERTISE: 24 words, 149 newspapers, \$6.50. Lists Free. Advertising Bureau, 4515-P Cottage Grove, Chicago.

BEST results; economical advertising; national circulation; leading dailies; Fidelity Advertisers, P-3838 Washington, Chicago.

20 WORDS, 10 magazines, \$2.00. Goodall, 37 Gardner, Vallejo, Calif.

YOUR Ad in Popular Science Monthly will produce profitable business for you. Rate is only 35c a word. Write for details. Dept. A-1, 353 Fourth Ave., New York City.

AGENTS WANTED

WANT Pleasant Outdoor Work in a business of your own? Good profits selling over 200 widely advertised Rawleigh home—farm necessities. Pays better than most occupations. Hundreds in business 5 to 20 years or more! Products—equipment on credit. No experience needed to start—we teach you how. Write today for full particulars. Rawleigh's, Dept. J-145-PSC, Freeport, Ill.

MAKE extra money easily. Sell 50 Assorted Personal Christmas cards for only \$1.00. Fourteen Box assortments 30c up. Odd cards 2½c each. Send for Free Samples exclusive \$1 line Personal Cards and Imprinted Stationery. Request \$1 assortment on approval. New England Art Publishers, North Abington, D-383, Mass.

CHRISTMAS Card Leaders bring you quick cash earnings. Name-imprinted Christmas Cards, 50 for \$1, up. Sensational "Prize" 21-card assortment sells \$1.00. You make 100% profit. 14 fast-selling assortments. Samples on approval. Chilton Greetings, 147 Essex, Dept. H-41, Boston, Mass.

WANT Agents for your products? An ad in this column will get them for you! Write today for full facts. O. K. Kelly, Classified Adv. Mgr., 353 Fourth Avenue, New York City.

SELL "Personal Initial" Christmas Cards—21 for \$1. Novel metallic gold, silver Initials included. 100% profit. 50 Name-Imprinted Christmas Cards for \$1. Many other fast-selling assortments. Samples on approval. Artistic, 370 Way, Elmira, New York.

CHRISTMAS Cards—Fast sellers. Sensational 21-card \$1 assortment pays 50c profit. Christmas Cards with sender's name, 50 for \$1. Outstanding, complete line money-making assortments. Experience unnecessary. Samples on approval. Schwer, Dept. D-5, Westfield, Mass.

BUY BY MAIL

Looking here for mail order bargains is like looking for food at a banquet. It's the natural thing to do! There's many worthwhile opportunities on these pages. You'll find all kinds of attractive buys . . . products and services for your home, car, radio, work shop, camera, hobbies and what not . . . in fact everything you need for your personal, family or business use at low prices. Please mention POPULAR SCIENCE CLASSIFIED when writing to advertisers. You will be treated fairly and courteously.

CHRISTMAS Cards. Earn \$2.00 an hour. Take orders galore from friends. 50 exquisite folders with name \$1.00. Free samples 25 designs. America's fastest selling 21 Christmas folder box. Costs 50c. Sells \$1.00. Request samples today. Sunshine Art, Dept. N, 115 Fulton St., New York City.

CALL on Friends with sensational lowest priced Personal Christmas Cards. Stationery. Names imprinted. Also big-value 21 Card \$1.00 assortment. Profit, 50c. Experience unnecessary. Samples on approval. Wallace Brown, 225 Fifth Ave., Dept. D-35, New York.

SELL 50 Christmas Cards with name for \$1.00! Four complete, sensational lines! 37 sparkling designs! Amazing values! Box assortments too. Big profits. Experience unnecessary. Samples Free. Noel Studios, 9 E. 26th, Dept. K-26, New York City.

BIG Money applying initials on automobiles. Easiest thing today. Free samples. If you sell printing and advertising specialties we have an excellent sideline featuring Decalcomania Name Plates in small quantities. "Ralco", 727 Atlantic Ave., Boston, Mass.

BIG profits selling famous Waltham Christmas Cards. 21-card \$1 assortment pays you 50c. Christmas Cards with name, 50 for \$1. Complete line. Samples on approval. Waltham Art Publishers, 160 N. Washington, Dept. 496, Boston, Mass.

MAKE extra money easy. Show smart Personal Christmas Cards with name, 50 for \$1, up. Outstanding values. Also 21-card assortment, \$1; others. Big profits. Samples Free. Wetmore & Sugden, 749 Monroe, Dept. 110, Rochester, N. Y.

I WILL Give You \$5.00 worth full size packages foods, groceries, soap, etc., Free if you agree to show friends and others. Amazing spare time money making opportunity. Write Zanol, 2316 Monmouth, Cincinnati, Ohio.

FREE water and our concentrates make 72 products. We supply labels, bottles. Enormous profits. Qualco, F-20030 Russell, Detroit.

NEW Process Name Plates. For Letter-boxes, door-bells, etc. Retail 15c. Samples 5c. Walker's, 30 Church St., New York.

SELL Christmas Cards. 50 cards with name \$1.00 with metallic underlays, embossing and cut-outs. 14 other assortments. Outstanding 21 card box. Large profits. No experience needed. Free samples. Southern Greeting Cards, Dept. 615, Memphis, Tenn.

\$1 STARTS you in business selling men's ties, ready tied Slyde-On-Ties and boxed novelties. Write today for descriptive wholesale catalog, free sample materials. Philip's Neckwear, 20 W. 22nd St., Dept. M-55, New York.

MAKE Money! Show exclusive Christmas Cards with customer's name, 50 for \$1, up. 100 designs. Also 21-card "Wonder Box" assortment \$1. You make 50c. Samples on approval. Janes Art Studios, 182 Anson Place, Rochester, N. Y.

AMAZING values, Sundries, Notions Novelties, Gifts, Military and Patriotic items. Postcard brings free catalogs. World's lowest priced wholesalers for 25 years. Mills Sales Co., 901 Broadway, New York.

MAGNETIC Sponge draws dirt from clothing. Used like brush. Saves drycleaning. Slick discovery. Samples sent on trial. Write "Inventor", 128 Kristee Bldg., Akron, Ohio.

WILL you give us 5% first \$600 you make? Afternoons free! Work home! \$1,000 month reported (exceptional—fulltime). Expect surprise! National, BX1240, San Bernardino, Calif.

START your own Bargain Clothing Business. Sell new and used shoes, dresses, coats, etc. Experience unnecessary. Free Wholesale Catalog. Superior, 1250-MD Jefferson, Chicago.

AGENTS: Opportunity make money; book containing 127 successful business plans; home-office; send for free introductory booklet, Elite Co., 214-A Grand St., New York.

GOOD Paying business silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. G, Decatur, Ill.

BIG Money taking orders; shirts, ties, hosiery, underwear, pants, jackets, raincoats, uniforms, etc. Sales equipment Free. Experience unnecessary. Nimrod, 4922-AV Lincoln, Chicago.

SELL New, Used Clothing from Home. Auto, Store, Men's Suits 77c, Leather Jackets 29c, Overcoats 43c, Dresses 10c, Ladies' Coats 33c. Other bargains. Catalog Free. S&N, 565-A Roosevelt, Chicago.

AMBITIOUS School Seniors—Sell Classmates the "tops" in Graduation Name Cards. Best Commissions. Free Cards. Agencies going like wildfire. Hurry! Craft-cards, Box 235-M, Pittsburgh, Pa.

PERSONAL Christmas Cards 50 for \$1.00. Also 15 other Box Assortments. Free Samples. A. B. Plateless Co., 243 Canal Street, New York, N. Y.

CHRISTMAS Cards—America's finest assortments. Big profits. Samples on approval. Robinson Cards, Dept. 130, Clinton, Mass.

SENSATIONAL New Concentrated Wall Shampoo. \$1.00 Profit every \$1.20 sale. Free Offer. Gallon Sample 25c. Thermo-new, Peoria, Ill.

DRESSES 10c—Shoes 50c, Coats 75c, Hats 40c. Free Catalogue. Crown, 164-PS Monroe St., New York.

EARN \$10—\$15 Daily applying beautiful, goldlike Sign Letters. Cost 1c. Sell for 25c. Free Samples. Hurry! Modernistic, T-3000 Lincoln Ave., Chicago.

MEN'S—Ladies' Topcoats 35c, Winter Coats 40c, Suits 88c, Pants 23c, Dresses 10c. Other bargains. Catalog Free. Portnoy, 566-W Roosevelt, Chicago.

WINDOW Sign Letters. New "Roman" Style. Large sizes—penny each—absolutely beautiful. Free samples—new catalogue. Atlas, 7941-R Halsted, Chicago.

NuSILVER Plating Polish. Apply with cloth. Cleans, silverplates and polishes at one time. \$1.00 postpaid. NuSilver, Dept. 112, Aurora, Ill.

POSTCARD "Labor and Capital Unity." For National Prosperity and Defense, 1c each. Joseph Galea, 362 W. 30th Street, New York City.

MERCHANTS Wall Cards—cost 1c. Sells 10c. Details. Eugene Collins, Biltmore, N. C.

YOU'LL like resilvering mirrors, tableware, making chipped glass nameplates, signs. Write Sprinkle, Plater, 910, Marion, Ind.

ELGIN, Waltham Wrist Watches, \$3.25. Send for free wholesale catalog. Louis Perloff, 729 Walnut St., Philadelphia, Pa.

FREE! Mexican Curios, Novelties. 100% profit! Marquez, Apartado 1176, Mexico City.

AGENTS—300% Profit selling Gold Leaf Letters; stores and offices. Free samples. Metallic Letter Co., 437 N. Clark, Chicago.

SELL Latex Products. Large profits. Send \$1.00 for samples, prices. Peerless, 4050-AE Broadway, Kansas City, Mo.

CHRISTMAS Cards. Big Profits. Everyone uses. Write for details. Freeman Cards, 33 High, New Haven, Conn.

DISTRIBUTORS For Aspercol Carded Merchandise Discounts, 2617 38th Ave., Oakland, Calif.

AMERICAN POLICE JIU JITSU

JIU-JITSU—Tested, simplified 20-lesson course by professional instructor. 25c coin. R. E. Schillinger, 1472 Broad St., Hartford, Conn.

ANTIQUES, RELICS INDIAN GOODS

GENUINE Prehistoric Indian Relics dug from graves and mounds in Tennessee and Kentucky. Also Fine U. S. Mint Stamps. Stamp for lists. Gill Johnson, 2808 Woodlawn Drive, Nashville, Tenn.

INDIAN relics. Confederate bills, coins, gems, crystals, minerals, curios; catalog 52 illustrations 5c. 100 ancient arrowheads \$3.00. Tomahawk head 50c. H. Daniel, Hot Springs, Ark.

12 BEAUTIFUL, perfect, prehistoric Arrowheads, \$1.00. Catalog free. Lear Howell, Glenwood, Ark.

SWORDS, Rapiers, Daggers, Pistols, Catalog 10c. Robert Abels, 860½ Lexington Avenue, New York.

25 GENUINE Indian Arrowheads, \$1.00. Catalog. Geo. Holder, Glenwood, Ark.

ASTROLOGY

LEARN true purpose of astrology. Sample free. The Rising Star, 3004-A E. 13th St., Wichita, Kansas.

AUTHORS' SERVICE

NEW Writer's needed! Free Test shows your ability. It's fun! No obligation. Rush postcard to Comfort Writer's Service, Dept. 723, St. Louis, Mo.

MANUSCRIPTS wanted for Publication. Renseb-PS, 30 Church, New York City.

AUTOMOBILES

AUTOMOBILE Racing Book, Fifth Edition—Illustrated. Tells how to build dirt track bodies, frames, engines Records, superchargers, rules, formula, plans, stock conversions, roadster racing, fast Fords. \$1.00 postpaid; \$1.15 C.O.D. Ray Kuns, Department 261, Madisonville, Cincinnati, Ohio.

WHIRLGAS, \$3, spins and vaporizes 5 miles per minute flow of carburetor mixture. Guaranteed mileage increase 20%; power 10%. Any car; give make, year. Wrench installs 15 minutes. John Hanley, Manufacturer, 5719 Loraine, Detroit, Mich.

INCREASE the horsepower of your Ford V8 from 85 to 128 HP—without supercharging. Send \$1.00 for detailed, simple instructions. Power Associates, P.O. Box 501, Wilmington, Del.

R & R MFG. Co., Anderson, Indiana. Racing cars, midgets and speed equipment. Catalogue 25c, Fuel Chart 75c. Instructions \$1.00.

AUTO SUPPLIES & EQUIPMENT

CONVERT your car to burn Diesel oil. Save up to 70% fuel costs. Cheap installation. Wonderful performance. Proven factory method. Different and better. Costs nothing to investigate. Write for free circular No. 3. Harrington Company, 201-204 Manchester Bldg., Portland, Oregon.

BARGAINS—Welders, compressors, battery chargers, car washers. Liberal trial terms. Write Hobart Equipment, Box P-1013, Troy, Ohio.

FUEL oil conversions—For automotive, marine engines. Write for free literature. Houston & Logan, 2112 Addison, Berkeley, California.

REFINE Used oil without cost. Particulars. C. Gerwin, Fairview, Oklahoma.

AVIATION

GET into Aviation! Earn \$2000 to \$5000 a year as Pilot, Mechanic or Aeronautical Engineer. We train you and assist Graduates in locating civilian employment essential to national defense. Big demand. School Government Approved. Write for information. Lincoln Airplane & Flying School, 2106 Aircraft Bldg., Lincoln, Nebr.

BUILD and fly your own motorcycle powered monoplane, home. Easy, cheap. Tested Plans, guaranteed \$1.00. Aerotech, Box 175, Dearborn, Mich.

SPECIAL—Ice, Snowsled, 3 blade propellers for any motor, lists free. Airliner, Ft. Worth, Texas.

PROPELLERS, all types, Catalog 10c. Banks Propellers, R.F.D. 7, Ft. Worth, Texas.

BATTERIES, GENERATORS, ETC.

EDISON lifetime storage batteries for light and power. Eliminate acid battery diseases. Long guarantee. All kinds rebuilt generating plants, motors, and miscellaneous articles at bargain prices. Free interesting literature. W. Hawley Smith Company, Croton Falls, N. Y.

GENUINE Edison Batteries for power, light. Non-acid, fifteen year life. Five year unconditional guarantee. Low prices. Complete lighting plants. Free literature. See-Jay Company, 87 Sterling Ave., Yonkers, New York.

BOATS, OUTBOARD MOTORS, ETC.

BOAT Blueprints and full size cut-to-shape paper patterns, \$3.75 up. Latest designs, all type pleasure boats, 8—38 ft. Illustrated "Build A Boat" catalog, 10c. (Book "How to Build Boats," \$1.00; Marine Hardware catalog, 10c). Cleveland Boat Blueprint Co., Station A-77, Cleveland, Ohio.

BUILD Your own boat. Bay City prefabrication saves time and money. Pay as you build. Engines, fittings, equipment, lumber. Investigate. Catalogue 100 boats 9 to 90 feet 10c. Bay City Boats, Inc., 1554 Adams St., Bay City, Michigan.

MARINE Power. Easily convert any Ford motor (domestic and foreign) with Osco Parts and Kits. Complete Catalogue 25c (coin). Osmithson, 3648-P Lawrence St., Philadelphia, Pa.

FORD A and V8—60 and 85 conversion parts, water cooled manifolds for other popular auto engines; hardware, etc. Marine Salvage, 113 Chestnut Street, Philadelphia, Pa.

OUTBOARD Motors, Used and Rebuilt. Save money. Used parts. Bargain list free. Crandall-Hicks, 955 Commonwealth, Boston, Mass.

MARINE Conversion Parts for all auto engines. Buy here and save. Conversion Parts Co., 277 Adams St., Boston, Mass.

KAYAKS, Outboards, Rowboats, Duck Boats. Weldwood ready-cut kits. Catalog I. Cre-Craft Boats, Millburn, N. J.

SAILKITS 100 sq. ft. \$4.95. Boat equipment reasonable. Alans, 98 Chambers, N. Y. C.

BODY-BUILDING COURSES

BAR-BELLS, Dumbbells, Exercise equipment. Courses. Special Offers! Free booklet. Good Barbell Co., Dept. 6, Reading, Pa.

BOOKS, PERIODICALS

ANY Book, (New, Used, Out-of-Print, Rare) Promptly Supplied! Lowest Prices! Send for Free Bargain Catalogues! Old Prof's Book Shop, S16, Arcadia Court, Pontiac, Mich.

SNAPPY books, pictures, novelties, etc. Where to get. We tell you. List only 25c. Esse Co., Dept. A, Baltimore, Md.

PRETTY Girl art photos, books, novelties. Big assortment \$1. Catalog 10c. P. S. Braun, 353 W. 47th, Chicago.

TRADE Magazines. Current numbers.

More than 200 different publications to choose from. Books of all publishers on advertising, selling, printing, engraving, etc. Lists Free. Discounts. Commercial Engraving Publishing Co., 34S North Ritter Ave., Indianapolis, Ind.

5c BUYS back dated magazines, Foreign, Domestic, Art. Also over 100,000 used and new books on Engineering, Sciences, Chemistry, Geology, Law, etc. Catalog 10c (refunded). Cicerone's Book & Magazine Center, 863 First Ave., New York City.

AN Independent Income without investment. My book, "Success!" shows how. Particulars free. Box 5386, Chicago.

ART Studies 15 to Set \$1.00. No Junk. Catalog 10c. E. G. Specialties, B, Carnegie, Pa.

BEAUTIFUL Art photos, sample 25c; real art film, 2 feet 25c. Shutt, Beach City, Ohio.

STEREOSCOPIC (three dimensional) Art Photos. Particulars for stamp. Oddity House, St. Petersburg, Fla.

HOLLYWOOD Art Photos. Assortment, \$1.00. Carlisle, 4519 Baker, Manayunk, Philadelphia, Pa.

"RUTHBELLA" (Sansicchi)—Love Diary, \$1.00. Private Press, 146-PC, Palisades Park, N. J.

BUILD IT YOURSELF

BUILD Your Own Machine Tools. Equip your shop at big savings. We furnish perfectly designed, shop-tested castings, professional blueprints and quality materials, for milling machine, shaper, band saw and 21 other metal and woodworking tools. Never a complaint on quality, design or price! Send 10c—32 page, illustrated catalog. Lewis Machine Tool Co., Dept. S-10, Box 116, Sta. A, Los Angeles.

BUILD power Scooters, midget cars. We supply tires, wheels, motors. Lowest prices. Send 10c for plans, etc. Build-Your-Own Devices, Dept. 10-B, 536 North Parkside, Chicago.

PROFESSIONAL Midget Racers, Two-passenger roadsters, Midget Motorcycles, motorscooters. Parts, plans, wheels. New Handbook catalog—125 illustrations, plans—20c. Midwest, Box 1959-BO, Chicago.

MIDGET Cars—Motor-scooters. Catalog building kits, plans, supplies—10c. New list 50 used motors priced \$4.00 up (also used midgets, motorscooters, parts)—20c. Shipps Midgets, Box 543-K, Zanesville, Ohio.

BUILD your own Tractor from second-hand automobile parts and save money. You can't go wrong. Write Nolan's Garage, East Wareham, Mass.

MOTORSCOOTERS, Midget cars! Easily built. Complete plans and literature on wheels, tires, motors, transmissions, etc., 10c. Honsaker, Masontown, Pa.

BUSINESS OPPORTUNITIES

BUILD your own Business. Popular Science Classified Ads will introduce your products into over 600,000 homes every month. These small ads have built big businesses for many men starting in the mail-order field. Send us a description of your products. We will prepare advertisements and submit them to you for approval. Address Class. Adv. Dept., Popular Science Monthly, 353-E, Fourth Ave., New York.

PLASTEX Industries offer industrious men an opportunity to start a business of their own, manufacturing art goods, novelties and utility products in Plastex and marble imitation. ½c material makes regular 10c store seller. Rubber molds furnished for speed production. Small investment brings big returns. We are now placing big Xmas chain store orders with manufacturers. Ambitious men have chance for real prosperity. Plastex Industries, Dept. S., 1085 Washington Ave., New York, N. Y.

INCREASED taxes make big demand for simplified bookkeeping system for tax reports. Sample \$5.50 Complete Yearly Record Book or 370 special sheets for filing stations sent postpaid, only \$2.00. Saves time, tax penalty worries. Satisfaction guaranteed. Twelve monthly filing holders included with prompt orders. Thrifty Bookkeeping Service, Danville, Ill.

ANNOUNCING new home study course in commercial baking. Good field. Nearly depression proof. Common school education sufficient. Send for free booklet "Opportunities in the Baking Industry" and requirements. National Baking Institute, 1315 Michigan, Dept. 1744, Chicago.

WANTED—men to cast Christmas Goods, 5 and 10c Novelties, Toy Autos, Ashtrays, etc. Can be done in any spare room, basement or garage and no experience necessary. A rare opportunity to devote spare or full time to profitable work. Write Dept. E., Metal Cast Products Co., 1696 Boston Road, New York City.

MECHANICALLY Inclined Men—Own and operate general Appliance Repair shop. Complete, illustrated course shows you how. Welding, Refrigeration, Motor repair, How to get business, etc., all phases covered. Free literature. Christy Supply, Dept. 309, 2835 N. Central Ave., Chicago.

START home business making statuary; plaques; art goods; novelties; souvenirs; concrete pottery; garden furniture; artificial marble flooring; liquid marble. Make your own flexible molds. Amazing profits. Valuable folder free. Creative Publishers, PS-10, Glenview, Ill.

COLOR Concrete with chemicals. Stucco-rock. Cement Artistry. Washing-wells. Spin concrete pottery. Benches. Garden Ornaments. Cold-glaze, concrete-paints, marbling. Sample 10c. Hollywood Cement-Craft, 8530 Wonderland, Hollywood, Calif.

MAIL Order business course shows you how to make money, spare or fulltime. Teaches professional mail order technique—not penny-catching schemes. Free details. Nelson Co., 500 Sherman, Dept. 407-K, Chicago.

MAKE Artificial marble, glazed tiles, moldless pottery, sanitary flooring, chemically stained cement, superhard figurines, latex molds. Uncanny cement secrets. Brilliant samples 3c. Payn, 945 Grand Vista, (Room 102), Los Angeles, Calif.

GOOD Paying Business silvering mirrors, plating autopaarts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. E, Decatur, Ill.

MAKE colorglazed concrete pottery, cemetery products, tiles, floors. Basement waterproofing. Other projects. Booklet, color-plates, details 10c. National Potteries, Minneapolis, Minn.

MILLER'S Formula Messenger, describing latest guaranteed, Chemist's Formulas for duplicating America's greatest-selling products. Free. Miller, Chemist, Tampa, Florida.

WILL you give us 5% first \$600 you make? Afternoons free! Work home! \$1,000 month reported (exceptional—fulltime). Expect surprise! National, Bx1240, San Bernardino, Calif.

"HOW To Make Money With a Duplicator", a 20-page booklet just published, will show you how to start profitable mail order business. 25c postpaid. C. O. Olson, 126-B, Grandy, Minn.

METALLIZING Baby-shoes makes you money! Simple! Novel! Perpetual market. Small investment, fine profits! Full particulars free. Novelty Metallizers, Box 933-S, Church Street Annex, New York.

MEN—Women, operate "Specialty Candy Factory" home, all or spare time. We help you start profitable business. (Our 32nd year.) Booklet free. Ragsdale Candies, East Orange, N. J.

FOOLPROOF Rubber, mold making, plaster casting, tremendous market, large profits. 24 page instructive catalogue free. Plastic's, 711 Neely, Muncie, Ind.

MOLD plaster novelties. Big profits. Rubber molds and materials. 24-page catalogue and sample XL mold material Free. Plastics, 711 Neely, Muncie, Ind.

100 BUSINESS Plans and formulas. Work home. Surprise literature free. Originators report up to \$200 a month. Treatise Service, Box 1439, Washington, D. C.

LATEST moneymaking propositions, magazines, ad-sheets. Ten monthly mailings, 10c. Lewis Co., 828-R Carpenter, Oak Park, Ill.

BE A Notary Public, make more money, legal field. Short course. Diploma awarded. Booklet. Institute, 30 W. Washington St., Chicago.

TIN cans converted to steel scrap, valuable tin, by chemicals. Process, sample of solvent, \$1.00. Harry D. Cater, 455 Washington St., Denver, Colo.

SIGNS and showcards easily and expertly painted with Letter Patterns. Many sizes and styles. Write for descriptive folder. John Rahn, B1330 Central Ave., Chicago.

LIQUID Marble — Marvelous, colorful! Brushed, sprayed, molded. Rubberlastic molds! Composition Flooring! Particulars free. Marbleizing Service, Edwardsville, Ill.

STOP Job Hunting. Start own typing and writing service. Free literature. Richard Business Service, 4340 Maple, Dallas, Texas.

127 WAYS to make money, in home or office, business of your own. Full particulars free. Elite Co., 214-A, Grand St., New York.

COLLECT Your Share of \$\$\$, Operate Collection Agency—Credit Bureau. Highly profitable. Easily learned. Capital unnecessary. Write Cole Associates, Syracuse, N. Y.

MAIL Order Dealers and Beginners. Write us for "Consultation without Obligation." Rodgers-Bennett, 239 Fourth Ave., Pittsburgh, Pa.

SELL By Mail! Ready-made circular service! Books, novelties, bargains! Catalog Free! Ellico, C-440 N. Wells, Chicago.

INCORPORATE your business. Sell shares. Raise capital. Free details. Corporation Fiscal Co., Box 1472-S, Wilmington, Del.

SOAPMAKING. Learn home. No machinery. (Stamp). Posera, D.J-4545 Bartlett, Milwaukee.

LEAKY Basements offer you exclusive profitable business. Sealseep, 1066, Cincinnati.

RAISE Angora Rabbits—wool brings \$5.00 pound. Particulars free. Grinstead, Carrollton, Ill.

HANDY men—Earn money home operating Community "Fix-It" Shop. Stafford, 708 Rawlings, Carbondale, Ill.

PROFIT From my mistakes in mailorder. Free details. Hayes, Box 1433-H, Oakland, Calif.

HOW can I raise capital for my business? Or sell my invention? Write Enterprise Bureau, Syracuse, N. Y.

MORE FOR YOUR MONEY

The same advertisers will be found in this Classified Section month after month and year after year. Reason—*Popular Science Classified Advertising Produces Profitable Results!*

For full details, write
Classified Advertising Department
POPULAR SCIENCE MONTHLY
353 Fourth Avenue, New York City

\$50—\$100 WEEKLY using Sawdust. Stamp appreciated. Clement, 843 Arthur, Rochester, N. Y.

WHERE to buy at lowest wholesale prices. Information free. Yorena, Box M-312, Bayonne, N. J.

HOW and where to obtain capital. Particulars free. Star Service, Wapakoneta, Ohio.

TURN Tin cans into money. Instructions 25c. Chaney, 1130 E. 16th St., Jacksonville, Fla.

START Lettershop In Home: Splendid Profit! Details: PSM-Lettershop, Madeira, Ohio.

MAIL and distribute circulars; wonderful opportunity. Miracle Factories, Conshohocken, Pa.

HOW To Sell services by mail profitably. Aristo, C, Plainfield, N. J.

BUSINESS SERVICE

WANT more business? Advertise your product or service in these columns. For details, write today to O. K. Kelly, Classified Adv. Mgr., 353 Fourth Ave., Dept. BS, New York City.

WE Collect Notes, Accounts everywhere. No charges unless collected. May's Collection Agency, Somerset, Kentucky.

CAMERAS, PHOTO SUPPLIES

MAKE money in photography. Learn quickly at home. Easy plan. Previous experience unnecessary. Common school education sufficient. Booklet and requirements free. American School of Photography, 1315 Michigan, Dept. 1741, Chicago.

FOLLOW the shrewd buyers who for 30 years have been writing Bass for camera bargains—still or movie. Used Cine-Kodak B. F.3.5 lens, \$22.50. Simplex Magazine, F.3.5 lens, \$22.50. Filmo 75, F.3.5 lens, \$31.50. Poth Derby, F.3.5 lens, \$12.50. Voigtlander Bessa, rangefinder coupled, F.3.5 lens, Compur Rapid shutter, \$48.50. Thousands of bargains listed in free Bass Bargaingram No. 242 Still Cameras—No. 245 Cine Cameras. Write for your copy. Money back guarantee. Bass Camera Company, Dept. SP, 179 West Madison St., Chicago, Ill.

CAMERAS and supplies. Free illustrated catalog listing everything photographic—still and movie cameras, films, lenses—at tremendous savings. Hundreds of bargains, new and used. All guaranteed. We take your old camera or equipment in trade. Write now for your free copy of our newest money-saving bargain book—just out! Limited edition. Hurry! Central Camera Co. (Photographic Headquarters since 1899), 230 S. Wabash, Dept. J-182, Chicago, Ill.

AMATEUR Photographers attention! Improve your hobby of picture taking and learn how to make money with it. Write today for our 40-page book catalog and a sample copy of American Photography, enclosing ten cents for postage. Contains articles and pictures of the world's foremost writers and pictorialists. Camera House 141, 353 Newbury St., Boston, Mass.

OIL coloring photographs a fascinating hobby or profitable business. Learn at home. Easy simplified method. Previous experience unnecessary. Send for free information and requirements. National Art School, 1315 Michigan, Dept. 1747, Chicago.

SPEED-O-COPY groundglass focusing attachment for Leica, Contax, Argus C-2 and C-3. Send for literature. D. Paul Shull, Dept. PS-10, 240 So. Union Ave., Los Angeles, Calif.

CAMERA Repairing. Bellows made to order, shutters repaired. Bellows made to fit, all standard cameras! United Camera Co., Inc., B-1515 Belmont, Chicago.

"ARTCRAFT" Light Diffusing material, Snapshot Titling, Wet Negative Printing. 15c Sheet, \$1.25 dozen. MS. Jacobson, 3510 Palmer, Chicago.

RETOUCHING unnecessary, sensational invention. Retouchoscreens, 355 S. Broadway, Los Angeles, Calif.

BIG discount Plan, anything photographic. New, used. Professional Products, PS-9, Cincinnati.

FASCINATING Single Picture Stereoscope \$3.50. Nu-Mirror Co., Bridgeport, Conn.

PHOTOGRAPHY is a leading hobby of Popular Science readers. This column offers an economical way to reach them. Advertise your product here and get more business! Classified Adv. Dept., 353 Fourth Ave., New York City.

CHALK TALK STUNTS

LAUGH producing program, \$1.00. Illustrated catalog 10c. Cartoonist Balda, Oshkosh, Wis.

CHARTERS

DELAWARE charters; complete service \$35.00. Submitted forms. Chas. G. Guyer, Inc., Wilmington, Del.

CHEMICALS & APPARATUS

CHEMISTRY Laboratory apparatus and chemicals for industrial, analytical, and experimental laboratories. Complete supply service for students taking correspondence school chemistry courses. Send 3c postage for free 44 page catalog. Dept. M26, Biological Supply Co., 1176 Mt. Hope Ave., Rochester, N. Y.

FREE Chemistry catalog. Supplies at 5c. Equip complete laboratory. Send 3c postage. Kemkit Corporation, 397B Bridge St., Brooklyn, N. Y.

HANDBOOK for Chemical experimenters. Illustrated, 50c. Experiment booklet and chemical catalog, 15c. Reading Scientific Company, Reading, Penna.

FREE booklet. Plant Experiments. Colchicine. Soilless. Hormoplant. Send stamp. Questop, Wellesley, Mass.

FREE Catalog: Chemistry, mineralogy, biology, microscopes, telescopes. Tracey Laboratories, Evanston, Ill.

LUMINOUS Paints will glow in dark. Five colors. Fairmount Chemical Co., 126 Liberty St., New York City.

SPECTROSCOPE for quick chemical analysis \$2.50. McCutting Sons, Campbell, Cal.

25 TEST Tubes, 4 1/2", resistance glass @ 30c. Scientific Exchange, Brooklyn, N. Y.

CHEMICALS in 5c quantities. Catalog 5c. Box 59, Elizabeth, N. J.

CHEMICALS in 5c quantities. Catalog 5c. Fleischer's Laboratories, Medford, Mass.

DETECTIVES

DETECTIVES—Work home—Travel. Experience unnecessary. Write, Wagoner, 2640-P Broadway, N. Y.

BECOME a detective. Opportunity to earn while learning. Free detective particulars. Raymond Stults, Bristol, Indiana.

DOGS, BIRDS, PETS

ST. BERNARDS—all breeds—details free! Book 104 photos, descriptions recognized breeds 25c. Royal Kennels, No. 80, Chazy, N. Y.

ST. BERNARD puppies. Champion sired beauties A.K.C. Franklin Young, R3, Riverhead, Long Island, New York.

EDUCATIONAL & INSTRUCTION

BIBLICAL Dietary Formula for World Peace and Everlasting Life revealed. Note: Pigs eat garbage and field rats. Rabbits are rodents. Shell fish are sea scavengers. Don't sin like Adam-Eve by eating forbidden food. Health Book, 100 pages, twelve cents. Dr. Deerbos, Box 41, Sta. A, Brooklyn, N. Y.

WELDING—Electric Arc. Learn quickly by actual practice at Hobart Welding School. Individual instruction at bare cost of materials used. 50c in stamps brings valuable welding lessons post paid and full particulars, Hobart Welding School, Box P-1014, Troy, Ohio.

LEARN Welding! Get into aircraft, ship-building, hundreds of important industries that need trained welders. Prepare now for good pay and future. Learn spare time at home if preferred. Write for Free facts. Utilities Engineering Institute, 1314 Belden, Dept. 31X, Chicago.

GET government jobs. Over 200,000 appointments yearly. New (low-cost) simplified, self-coaching service covers most popular positions. Particulars free. Modern, 1123-S Broadway, New York.

U. S. GOVERNMENT Jobs Now Open. New study course. No cost until on Government payroll. Free information. Civil Preparatory Service, 1702-B N. LaSalle, Chicago.

WANT Security? Get Government Position. Men—women, 18-50. Good salaries. Thousands needed yearly. Prepare now for next suitable Examination. Write, Instruction Service, 166, St. Louis, Mo.

\$105-\$175 month. Men-Women. Get U. S. Government Jobs. Prepare now for examinations. Particulars free. Franklin Institute, Dept. C33, Rochester, N. Y.

CLINICAL Laboratory Technic taught in your own home. Practice outfit supplied. Bulletin free. Imperial Technical Institute, Box 494-B, Elkhart, Ind.

LEARN Telegraphy! Splendid opportunities now prevail. All expenses low. Catalog free. Dodge's Institute, Harmon Ave., Valparaiso, Ind.

TOOL designing pays big. Home study course. Low cost. Easy terms. Free booklet. Ohio Institute of Technology, Dept. 25, Greenville, Ohio.

ENJOY Health. Become Professional Acrobat. Free health book. Write! Emil Knoff, 2154SF North 52nd St., Milwaukee, Wis.

PART Time Bookkeeping pays big. Fifteen lesson course. Fireside Educational Institute, 5542-S South Homan, Chicago.

ELECTRICAL SUPPLIES & EQUIP.

TURN Lights on, off, one to fifty places. On three way switches. Cheaper. Instructions fifty cents. R. Hahn, Coalport, Pa.

FREE 1941 Catalog. 1000 electrical bargains. LeJay Manufacturing, 823 LeJay Bldg., Minneapolis, Minn.

ELECTRIC Pencil: Writes. Engraves all Metals. \$1.00 postpaid. Beyer Mfg., 4515-C Cottage Grove, Chicago.

ENGINES, MOTORS, ETC.

$\frac{1}{2}$ HORSE. 110 volt, induction motors. Rebuilt, guaranteed \$8.00; other sizes. Wilmot Auto Supply, 2247 St. Paul Ave., Chicago.

BARGAINS—Welders, electroplating, motor generators, guaranteed, liberal terms. Write Hobarts, Box P-1011, Troy, Ohio.

AIR Compressors $1\frac{1}{4} \times 1\frac{1}{4}$ \$6.00; 2×2 \$7.00; $2\frac{1}{2} \times 2$ \$8.00; Electric drills $\frac{1}{4}$ in. \$5.95. Free Folder. National, 1915 S. State, Chicago.

$\frac{1}{2}$ HORSE. 3450 speed, Repulsion Induction, Alternating Motors \$10.50; 500 Watt, Alternating Generators \$22.50, other sizes. Butler Electric, 1885 Milwaukee, Chicago.

REBUILT motors, complete stock. New motors; drills; grinders; fluorescent fixtures; Home workshop tools. Mailorder Electric, 705 S. Dearborn, Chicago.

MOTOR Winding Data, selection single and three phase, \$1.00. Motor Data, Box 7631, Kansas City, Mo.

FARMS, OTHER REAL ESTATE

GOOD Farm Bargains. Washington, Minnesota, Montana, Idaho, Oregon, North Dakota. Dependable crops, favorable climate. Write for literature and lists describing typical farms for sale. Specify state. J. W. Haw, 120 Northern Pacific Ry., St. Paul, Minn.

RIVERSIDE Farm; \$800 Down—29 fertile acres fronting concrete highway; furnished 8-room house, bath, gas, electricity; barn, poultry house; only \$1800; page 43 Free catalog 1250 bargains many States. Strout Realty, 255-ZB 4th Ave., N.Y.C.

SEE The Highlands of Louisiana. Choice cut-over land selling on liberal terms. Descriptive book sent upon request. Long-Bell Farm Land Corp., 874 R. A. Long Bldg., Kansas City, Mo.

40 ACRES, near White River, unimproved; poultry land, \$190; \$5 down, \$5 monthly. Free list and literature. Hubbard, 269 Grossman Bldg., Kansas City, Kan.

FIELDGLASSES, TELESCOPES & MICROSCOPES

LENSES—Build your own telescope, field glass, microscope, rifle scope, etc. Assortment of fifteen lenses—\$1.00 postpaid. Slightly chipped on edge. Satisfaction absolutely guaranteed. American Lens Company, 324 N. Mayfield, Chicago.

ASTRONOMICAL Telescopes, binoculars, cameras, microscopes; bought, sold, repaired. Send 10c for list of instruments desired. Rasmussen, Box 294, Amsterdam, N.Y.

TELESCOPES, Microscopes, Binoculars; bargain catalog free. Brownscope Co., 5 West 27th St., New York.

FOR THE HOME

VACUUM Cleaners—New and Rebuilt; Parts, Attachments, Lowest Prices. Vaco, P.O. Box 81, Clifton, N. J.

FOR INVENTORS

INVENTORS: Take first step toward protecting your invention—without obligation. Send for free "Record of Invention" form—and free "Patent Guide" containing instructions on how to patent and sell inventions; details of search service; convenient payment plan. Write today, Clarence A. O'Brien, Registered Patent Attorney, 1K2A Adams Building, Washington, D. C.

INVENTORS: Unpatented inventions now salable with positive safeguards under patent laws. New, low-cost procedure. Complete details, free. American Patents Corporation, Dept. 12, Washington, D. C.

INVENTORS: Write immediately for two free books, "Patent Protection" and "Selling an Invention". Explain many interesting points to inventors. "Evidence of Invention" form enclosed. Reasonable fees, forty-three years' experience. Avoid risk of delay. Address: Victor J. Evans & Co., Registered Patent Attorneys, 432-L Victor Building, Washington, D. C.

DEVELOPING your idea into marketing article, dies, tools for rapid production is our hobby. Write us. 50 years experience. H & H Tool Mfg. Co., Dept. A, 308 E. 3rd, Cincinnati, Ohio.

PATENT, Trademark, copyright research service. Complete service for inventors. Reasonable fees. Preliminary information free. Inventor's Service Bureau, Chandler Bldg., Washington, D. C.

WE locate buyers meritorious patented, unpatented inventions. If will sell, reply immediately. Descriptive booklet, references, free. Invention Reporter, 3A-11236 South Fairfield, Chicago.

HAVE you a sound, practical invention for sale, patented or unpatented? If so, write Chartered Institute of American Inventors, Dept. 3-A, Washington, D. C.

SELL your own invention. Patented or unpatented. Instructions. Names of manufacturers, \$1.00. Commission Development, Box 692, Binghamton, New York.

CASH for practical ideas and inventions. Mr. Ball, BB-9441 Pleasant, Chicago.

WANTED! Small Inventions; patented, unpatented; cash, royalty basis. Traphagen Co., 307 E. St. Clair, Indianapolis.

FORMULAS, PLANS, ETC.

AUTHENTIC Formulary. 924 pages. (Illustrated.) Recipes, instructions—10,000 profitable products. \$1.50 postpaid or C.O.D. (Foreign \$1.85.) Catalog 3c. Adams-Brown, Chestnut Hill, Mass.

NEED a chemist? Competitive formulas. Development. Consultant Chemist, Claymont, Delaware.

FORMULAS—Latest, best. Analysis. Literature free. E. Belfort, Engineering Bldg., Chicago.

FORMULAS! Cheapest! Best! No Machinery, list free. White, Box 2926, Dallas, Texas.

LATEST simplified Formulas. Best selected. 1 $\frac{1}{4}$ c each. Baran, Bay City, Michigan.

FORMULAS. All kinds. Guaranteed. Catalog free. Kemico, 500, Parkridge, Ill.

HELP WANTED

BIG uniform manufacturer seeks man to contact restaurants, beauticians, doctors, nurses, factories, offices, homes, others. Offer exclusive, patented styles; unsurpassed workmanship. Special assortment Peggy Parker bargains. Leads furnished. Permanent. Outfit Free. Hoover, 251 W. 19th, Dept. YK-18C, New York City.

MEN Wanted—Auto-Diesel Mechanics. We pay your railroad fare to Nashville. Let us train you to be an expert mechanic and help you get a good job. The cost to you is small. For free booklet write Nashville Auto-Diesel School, Dept. 269, Nashville, Tenn.

STEADY Work—Good Pay. Reliable man wanted to call on farmers. No experience or capital required. Pleasant work. Home every night. Big Money every day. Some making \$100 in a week. Wonderful new proposition. Particulars free. Write McNess Co., Dept. 552, Freeport, Ill.

PRESS card in your name, \$1. Cover your town; good earnings. Chief, Press Radio Service, 1934—11th, Washington, D. C.

SALARIED Positions quickly obtained. Instructions 25c. George Lenhoff, Federal Securities Bldg., Lincoln, Nebr.

HIGHGRADE SALESMEN

ADVERTISING Book Matches — World's largest "Direct Selling" Book Match Factory offers advance cash earnings calling on every type of business. Experience unnecessary; full, part time. Low prices for high quality; quick deliveries, help you get orders. Good repeat profits. Free Kit, Instructions. Match Corp. of America, 3433 West 48th Pl., Dept. N-10, Chicago.

SELL Business Cards, stationery, book matches, gummed tape, restaurant necessities, salesbooks, advertising specialties, pencils, picture cards, tags, pricing sets. Lowest prices. 40% commission. Experience unnecessary. Free deals. Sales portfolio free. Willens, 2130 Gladys, Dept. 710, Chicago.

MAN with car to cover retail store route. Openings almost every locality. Handle orders for nationally known manufacturer—jobber. Average 50% commission. Steady big pay opportunity. Sales experience unnecessary. World's Products Co., Dept. 83-S, Spencer, Ind.

YOUR ad in this Classification will reach productive sales-getters for your products or services. Rates on request. Popular Science Classified, 353 Fourth Ave., New York, N. Y.

GREATER Christmas Profits! Fifty Imp-print Cards 20c! Dollar Box Assortments 33c! Calendars, Wreaths, Pictures, Novelties! Catalog Free! Three Boxes \$1.00. Fantus, 440 N. Wells, Chicago.

CALENDARS—Beautiful Complete Line all sizes, including Jumbos, Samples free. Start now, be the first in the field. Fleming Calendar Co., 6539 Cottage Grove, Chicago.

CHEMICAL discovery every filling station wants every day. Exclusive distributors make real profits. Anchor, 1521 Grand, St. Louis.

BLADES—Big profits. Best quality. Factory prices. Postpaid. Ace Blades, Buffalo, N. Y.

SELL our big bargain work Gloves to Stores Only. Catalog free. Kriewaldt Mfg. Co., Oconto, Wis.

34 WAYS to Make Big money Selling Advertising. Free Folder. Julian Crum, 728 N. Topeka, Wichita, Kansas.

RULERS, Yardsticks. Popular high grade line. Tuttle, Canisteo, N. Y.

HOBBIES, COLLECTIONS

MATCHBOOK Album: Collectors, Travelers, write Adams Sales, State Tower, Syracuse, N. Y.

BEAUTIFUL assorted Jewelry Stones, (new) 200 for \$2.00 postpaid. Moore's, 651 S. State, Chicago.

HOME CRAFTSMEN

28 LAWN Ornament patterns 25c. Other patterns: 15"-20" high; Dutch girl, Dutch boy, pirate, bull terrier, Mexican girl, Mexican boy, dwarf, penguin, flower girl, 10c each; 3 for 25c. 25 Novelty patterns, 30c. All 62 full size patterns \$1.00 postpaid. Strother, Box 383-CX, Belington, W. Va.

SQUAREKNOTTERS! Make belts, handbags, etc. Quality cord samples with catalog free, beginner's book, catalog and samples, 10c. Special! Regular \$1 book with 50c beginner's outfit, all for \$1. P. C. Herwig Co., Dept. P-34, 121 Sands St., Brooklyn, N. Y.

TO get more business, advertise your projects for Home Craftsmen in this column. Details on request. O. K. Kelly, Classified Adv. Mgr., 11th floor, 351 Fourth Ave., New York City.

GET Free Leathercraft instruction pamphlets, prices of leathers, tools, projects. Make extra money—gifts. Leather samples 5c. Wilder & Co., 1038 Crosby, Dept. A-10, Chicago, Ill.

LEATHERCRAFTSMEN: Send 10c for handbook and catalogue of tools and supplies. E. A. Sweet Co., Inc., Leathercraft Division S-15, 148 State St., Binghamton, N. Y.

PATTERNS: Lawn Ornaments, Silhouettes, Plywood Novelties, Decal Transfers and other Supplies. New Catalog illustrates 500 articles. Wo-Met Shop, Ashburn, Ga.

VENETIAN Blinds, supplies, machinery, wholesale. Catalog 10c. "Manufacturing Booklet" \$1.00. "Roberta", Box 260, Gloversville, N. Y.

CHAMBERLAIN Metal Weatherstrips. Radiator Cabinets. Own Installation. 212 Fitzsimons Building, Pittsburgh, Pa.

MEXICAN Novelties easily made! 20 patterns complete instructions 25c. Mex-Artcrafts, Eagle Pass, Texas.

KNOCKDOWN Cedar Chest, Foreign and Domestic Veneers, Lumber. Catalog 10c. Giles, Kendall Co., Decatur, Ala.

LEARN to Polish Gems. Free information. Smith's Agate Shop, 228 Alder St., Portland, Oregon.

27 FULL Size novelties, patterns 25c. Modern Woodcraft, Saginaw, Mich.

HUNTING

HUNDRED Hunting Hounds Cheap. catalogue. Elton Beck, O-39, Herrick, Ill.

INVENTIONS WANTED

LARGE aircraft tool and parts manufacturer in the market for patented or unpatented ideas or inventions assisting the national defense program, or items to manufacture after the present emergency. Send sketches, blueprints, or explanations to Box 2004, Sta. V, Los Angeles, Calif.

SIMPLE, practical inventions wanted by manufacturers, patented or unpatented. For information write Chartered Institute of American Inventors, Dept. 3-C, Washington, D. C.

SMALL inventions wanted by manufacturers. I'll help you sell your invention. Write for free circular. S. Hull, 7829-M Euclid Ave., Cleveland, Ohio.

INVENTIONS Promoted. Patented or unpatented. Write Adam Fisher Co., 183-A Enright, St. Louis, Mo.

CASH for Inventions—Patented or unpatented. Mr. Ball, BC-9441 Pleasant, Chicago.

INVENTORS! Have you good, patentable idea? Write Dept. 72-T, Box 19, Sta. "M", New York.

JEWELRY

WATCHES, Elgin, Waltham, etc. \$1.69 up. Wincholt, Box S2, Woodbine, Pa.

LEGAL DIRECTORY

MEXICAN Legal matters, Wm. Cocke, Reliable Amer. Atty., El Paso, Texas.

MACHINERY, TOOLS & SUPPLIES

DRILL Grinding attachment, price \$8.85, used with bench grinder. Literature on request. Tractor-Life Co., Sidney, Iowa.

THE New Shebel Saw Filer produces saws that have no equal. Send for full information. A. P. Shebel, 728 S. 2nd St., Milwaukee, Wis.

MAGIC TRICKS, PUZZLES, JOKER NOVELTIES

HOUSE of 1000 Mysteries! Famous coast to coast! Professional Magic! Pocket tricks! Joke Novelties! Two catalogs in one! Giant Illustrated Edition 10c. Vick Lawston, Dept. P70, Queens Village, N. Y.

JUST Out! New 1941 Catalog 500 Tricks. All the Latest Magic. Easily learned. You amaze—mystify friends at once. Large assortment. Lowest prices. 100 pages, profusely illustrated. Send 10c today! Lyle Douglas, Magicland, Dallas, Texas.

WORLD'S largest professional magic shop keeps you in touch with latest tricks. To receive mailings send 25c for 1941 catalog. Holdens, P-220 W. 42nd St., New York.

FREE Catalog Magicians use, systems, methods, cards, dice, punch boards, slot machines. Book Company, Box 671, St. Louis, Mo.

HOLLYWOOD Special! Magicians button, catalog, ghost illusion and free trick for 25c. Magic House of Charles, Box 888S, Hollywood, Calif.

BULLETIN 9 features "Short Changing" Genuine Bill. Test Copy 25c. Ivan, 104 Grand St., Brooklyn, N. Y.

FREE Trick and Professional Magic Catalogue 25c. St. Louis Magic Studio, 418 Olive, St. Louis.

BOOKS; Tricks, Cards, Novelties, Catalog. Samples 25c. Easterncity Sales, 32-We Randolph, Chicago.

MAGICIAN'S Headquarters. 216-page illustrated catalog. 25c. Kanter's, S-1311 Walnut, Philadelphia.

JOIN Magicians' Fraternity! Free Tricks! Monthly Magazine, sample 10c. International Magicians, Mount Morris, Ill.

MANUFACTURING

MANUFACTURING any material, any quantity, inventions developed. Milburn, Burlington, Ky.

MINERALS & PRECIOUS STONES

ALEXANDRITES from 3 carat up \$1.25 per carat. Three genuine Zircons \$1.75. Lowe's, Box 525, Chicago, Ill.

GOLD Ore 6 specimens 25c. Miner, 710 Federal, Denver, Colo.

MISCELLANEOUS

COMIC Pen and Ink Sketch made from your photograph. Picture returned unharmed. State hobby or pastime. Send photo and \$1 to Fred Gabb, Jr., 1298 S. Lauderdale, Memphis, Tenn.

DRUG Sundries, specialties, supplies, etc., mailed directly by manufacturer. Send for free mail-order catalog, saving 75%. Mail-Order, Dept. 5A, Box 231, Hamilton, Ontario.

DEAFNESS. Why? Good hearing without mechanical aids. No drugs. Relieving deafness. Johnstone, Sta. C, Vancouver, Canada.

FOUNTAIN Pen—American, Very Fine Quality, easily worth dollar. Send 50c coin. Sandick Stationery Est., 7523 New Utrecht Ave., Brooklyn, N. Y.

MISSING Heirs! Authentic Lists! 2,000 unclaimed Legacies \$1.00; 150 10c. Duffey, Covington, Ky.

RECEIVE gigantic mails, magazines, samples. Your name in numerous mailing lists 10c. Howard, 396 Broadway, New York.

FREE literature how to locate buried treasure and minerals. Fisher Laboratory, Palo Alto, Calif.

ORCHID 50c. Free catalogue and instructions. Quivira Specialties, Winfield, Kansas.

FUN to Kill flies with New Gun. Free circular. Kayler Fly Gun, Kankakee, Ill.

HEAT Six Rooms \$20.00 yearly. Details 10c. Rosensweig, R 10, Cincinnati.

MODELS & MODEL SUPPLIES

FREE! New Big catalog of record breaking models. 52 picture packed pages, drawings and other information makes this a modeler's reference book. Includes airplanes, speed boats, race cars, radio control. Enclose 10c handling charge. Berkeley, Dept. 1-S, 230 Steuben Street, Brooklyn, N. Y.

THOUSANDS ship fittings, hundred kits, catalog 10c. Polk's, 429 Seventh Ave., New York.

SPEEDBOAT 20"x7" completely prefabricated kit. Mahogany trim. Propeller, tube, rudder, plans and instructions \$3.95 postpaid. "Bermoco", Berwyn, Md.

CARVED Hull ship model kits. Ship and yacht model fittings; model yacht sails. Illustrated catalog 20c. A. J. Fisher, 1002-M Etowah Ave., Royal Oak, Mich.

MOST complete Illustrated Catalog—"O-HO OO" Model Railroad Parts ever published. Send 5c for mailing. Selly, 1377 Gates Ave., Dept. 804, Brooklyn, N. Y.

BALSA Knife; extra keen. Ebony, coco-bolo handle. 60c postpaid. "Bermoco", Berwyn, Md.

MODEL Supplies for the Inventor. Catalog 3c. Pierce Model Works, Tinley Park, Ill.

MONEY MAKING OPPORTUNITIES

YOUR Own Profitable Business! We help you to build up successful subscription agency in your community, making money year after year with new and renewal orders for all magazines published. Our representatives also make big profits with extremely beautiful Christmas cards—our own complete, fast-selling 1941 line. No experience required. So turn your spare time into cash! Clip this ad now and mail with your name and home address to International Circulation Co., Inc., Dept. AB-2, 57th St. at 8th Ave., New York, N.Y.

MAIL Galore! Your name on numerous mailing lists. Brings latest opportunities, catalogs, samples, etc. 25c. Hill Bros. Supply Co., 203-A Sexton Bldg., Minneapolis, Minn.

BE A Metascientist. Remarkable drugless healing system. No apparatus. No manipulation. Inexpensive correspondence course. Information free. Metascience, DeLand, Florida.

BE a professional scrapbooker. Big fees, Unlimited opportunities. Can be done at home. No competition. No capital needed. Write to Scrapbookers Guild, 62 Park Place, New York, N. Y.

EXTRA Income! No Selling. Operate Vendors, \$3.95 up. See Sally Rand, Nude Ranch, others. Hand Viewer, two snappy girl films (28 pictures), \$2.00 postpaid. Automatic, 2422-L Fullerton, Chicago.

JOIN co-operative group investigating spare time opportunities. Learn way earning extra income. Details 10c. Write Money Makers, Dept. 10J, Covina, Calif.

YOUR name on 5,000 mailing lists—25c. Get free samples, opportunities, galore from all over world. Eastern, S-961 46th, Brooklyn, N. Y.

BOOKKEEPERS—Profitable part time accounting work. Ralph Lee, Vicksburg, Mich.

OPPORTUNITIES. Two big magazines, 1/4 lb. mail, 25c. Pasco, 11444 Michigan, Chicago.

OPPORTUNITIES, moneymaking ideas galore with 64 page magazine, 10c. Dohrmann, Box 109, Madison, Wis.

AMATEUR Cartoonists, earn money evenings, copying cartoons for advertisers. Adservice, Argyle, Wis.

COMIC Bowling League Membership Certificate. Every bowler buys. Sample 10c. Kant Novelties, 3238 Third, Pittsburgh, Pa.

OPPORTUNITIES Galore, giant mails 10c, sample mailing free. Harvey Teeple, (PS), Decatur, Ind.

YOU'LL like resilvering mirrors, tableware, making chipped glass nameplates, signs. Write Sprinkle, Plater, 920, Marion, Ind.

MOTION PICTURE & SOUND EQUIPMENT

LOOK! Nationally advertised movie cameras, projectors, films, accessories. Payments low as \$2.50 monthly. Send stamp for literature and close out bargains. Don Elder's, P-741 Boylston St., Boston, Mass.

8-16-35MM FILMS. Bought, Sold, Exchanged. Silent-sound subjects \$2 up. Odd reels \$1.50. 1000 feet 35MM 95c. Arts. Lists 5c. SOD Recordings, International, 2120 Strauss, Brooklyn, New York.

AMBASSADOR Movie camera film 100' nonhalation 16mm \$1.98, 25' double 8mm 98c. Reversal processing included. Ambassador, 479-A Quincy St., Brooklyn, N. Y.

8-16MM Films silent-sound, bought, sold, exchanged. Films rented everywhere. Free catalogue (with sample art 10c). Garden Film, 317 West 50th, New York.

LEARN Motion Picture projection, man-agement. Free Catalog. Giveage Theatre Institute, 375 Washington, Elmira, N. Y.

3-16MM Art films. Free catalogue (sample 10c). Parkway Exchange, 961 Eastern Parkway, Brooklyn, New York.

DEVELOP your own movies. Complete instructions 10c. Corona Laboratories, 200 E. 34th, Brooklyn, N. Y.

CAMERAS, Projectors, Films, Lists, free. (Sample film, 10c.) Box 337, Valley Stream, N. Y.

"DIFFERENT" home movies. Sample, catalog, dime. Falstaff, Room 901, Michigan-Ohio Bldg., Chicago.

RAPID Exchange, 50' 8mm, 25c. Milestone, 1414-24, Galveston, Texas.

ART film catalogue (sample 10c). Midwest Cine Shop, Box 11, Hannibal, Mo.

MOTORCYCLES, BICYCLES & SUPPLIES

MOTORCYCLE parts, accessories. Most complete stock. New & used. We specialize on Mail orders. What do you need? 35 page catalog 10c. Whitman Motorcycle & Supply Co., 405-9 Southwest Blvd., Kansas City, Mo.

BUILD And Sell 2 hp Midget Car, 1 hp "Scooter", "Soapbox" racer engine. Electric "bike" motor—many others. Complete plans, photos, drawings in new 68 page book. Only 75c (U.S.) stamps. Midget Mfgs., Dept. PS-10, Kearney, Nebr.

ALLOY Pistons—\$3.50 Harley, Indian, Henderson, Cleveland, Cylinders re-ground, scores welded, new and used parts for less. Catalogue and wings pin 10c. Ballak, 811 N. 9th, St. Louis, Mo.

MOTORCYCLES, reconditioned. New, used, parts and accessories. All makes. Large stock. Bargains. Illustrated catalog, 15c. Indian Motorcycle Sales, Kansas City, Mo.

MUSIC, MUSICAL INSTRUMENTS

MUSIC composed to words. Rhyming pamphlet on request. Phonograph recording of completed song. Send poem. Keenan's Studios, Dept. PS, Box 2140, Bridgeport, Conn.

PIANO By Ear! Complete 6 easy lessons. \$1.00 pays for entire course; no more to pay ever. Send \$1.00 for Harlem Method or order C.O.D. play any song or tune. Harlem Co., Dept. P-84, 30 Church St., New York

CHORD chart, all notes harmonized, 45c. Music Shorthand, speeds writing, 85c. Both \$1. P. Stackpole, 2110 W. Venango, Philadelphia, Pa.

BEGINNERS! New Piano Book. Learn to read notes and play popular music the "Simplified Way". Free information. Moreau Studio, Conrad Bldg., Providence, R.I.

LEARN Swing piano! Postal brings free folder. Christensen, 465 Kimball Hall, Chicago.

SONG Poems wanted. Free examination. McNeil, Master of Music, 510-PS South Alexandria, Los Angeles, Calif.

WANTED! Lyrics, melodies for songs. We arrange, publish, sell. Superior Song Studios, Passaic, N. J.

VIOLIN without notes. Free Booklet. Melody Masters, Dept. B, Beloit, Wis.

PIANO By ear. Free booklet. Write Day-V-Way, Dept. 8-B, Dearborn, Mich.

PIANO Repair Material, piano parts. Hall Music Co., Waco, Texas.

OLD GOLD, WATCHES, PRECIOUS STONES

GOLD \$35 ounce. Ship old gold teeth, crowns, jewelry, watches—receive cash by return mail. Satisfaction guaranteed. Free information. Dr. Weisberg's Gold Refining Co., 1500-B Hennepin, Minneapolis, Minn.

GEMS, Agate, Minerals, Jewelry. Six rough gemstones—Emerald, Sapphire, Garnet, Topaz, Fireopal, Agate, \$1.00 postpaid. Catalog. Hull Co., Route 7-K, Salem, Oregon.

ELGIN, Waltham Watches \$3.50. Make big money. Free watch and jewelry catalog. Plymouth Jewelry Co., 163-B Canal St., N. Y.

WANTED! Gold, silver, platinum, diamonds, mercury, etc. Ship! Simon's Jewelry, 353 Old Arcade, Cleveland, Ohio.

PATENT ATTORNEYS

INVENTORS: Before disclosing your invention to anyone send for Form "Evidence of Conception"; "Schedule of Government and Attorneys' Fees" and instructions. Sent free. Lancaster, Allwine & Rommel, 413 Bowen Building, Washington, D. C.

INVENTORS: Take first step toward protecting your invention—without obligation. Write for Free "Record of Invention" form for establishing date of invention and Free "Patent Guide for the Inventor"—telling importance of prompt action, confidential search service; how to sell inventions; convenient payment plan. Send for "Patent Guide" and "Record of Invention" form today. Clarence A. O'Brien, Registered Patent Attorney, 1K2B Adams Building, Washington, D. C.

VICTOR J. Evans & Company, 431-L Victor Bldg., Washington, D. C.—one of World's largest firms of Registered Patent Attorneys, established 1898—will send you free—68 pages of facts for inventors. Two plainly written books tell you how to apply for patent—give six basic methods of selling your invention. Fees reasonable; terms arranged. Delay may be costly; write today.

INVENTORS—Delays are Dangerous—Secure patent protection now. Get new Free booklet, "How to Protect Your Invention." No charge for preliminary information. McMorro and Berman, Registered Patent Attorneys, 143-Z Barrister Bldg., Washington, D. C.

INVENTORS: Send for free copy my 72-page book on patents. Reasonable terms. Prompt action. Confidential, personal service. L. F. Randolph, Dept. 340-A, Washington, D. C.

PATENTS—Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 724 Ninth St., Washington, D. C.

"INVENTOR'S Guide" free; full information about patenting, selling inventions. Frank B. Ledermann, 154 Nassau St., New York.

\$35.00 ATTORNEY'S Fee in some cases. Free particulars airmailed. Robert Beck, 2210 Barrister Bldg., Washington, D. C.

PATENTS

WE Successfully sell inventions, patented and unpatented. Write us, if you have a practical, useful idea for sale. Chartered Institute of American Inventors, Dept. 3-B, Washington, D. C.

PATENTS FOR SALE

DECORATIVE Switch Plate, patented. Outright sale or royalty. Ernest Bender, Conrad, Montana.

PERSONAL

GRANDMA'S Fruit Laxative Made of fruits instead of drugs. Tested over twenty years. Tastes like candy. Six months family supply made in 30 minutes. Send dollar bill or check for formula. Grandma's Fruit Laxative, 629 S. Lucerne Blvd., Los Angeles, Calif.

RADIANT Health. Vigortex Wheat Germ! We guarantee to improve your health or refund your money. Three weeks supply for \$1.20 prepaid—West of Mississippi \$1.45. Kretschmer Corp., Dept. PS, Saginaw, Mich.

DISCOVER your hidden powers. Ontology (Science of Reality) promotes happiness, prosperity, companionship; teaches mind healing, explains how to pray understandingly. Interesting literature free. Write Alexander Keene, D-651 S. State, Chicago.

YOU'LL Love prestige of N.Y. Bank Checking-Account! No minimum—balance required! \$1.00 opens account. Advantages. Write now for details. FMR Service, 1457-C Broadway, N.Y.C.

VALUABLE advice on any subject confidential \$1.00. Helpful advice on Domestic Problems that trouble you. Everyone of importance write World's Master Advisor. John M. Riddel, Johnstown, Pa.

WIN prize money: Booklet, "Successful Contesting", shows how—10c, postpaid. Bulletin listing \$100,000.00 prizes included. World Publishers, 4515-L Cottage Grove, Chicago.

PURCHASE drug sundries at tremendous saving without embarrassment. Send for our Special no cost offer. Sherrell Products, Box 54-A, Rochester, N. Y.

SILK Insurance. Conserve Hosiery and Lingerie. Strengthen fabrics, colors unaffected. Details \$1. Clark Collins, Box 1244, Hollywood, Calif.

ART Pretty girl pictures, postcard size, 12 for \$1.00; size 3"x4" 20 for \$1.00; sample package 50c. Harlem Co., 309 W. 125th St., Box 10, New York, Dept. A2.

BULK Drugs, Oils, Chemicals. I undersell everybody. Get my price on anything you use in large quantities. Frank Patterson, Hawesville, Ky.

SINUS Trouble. If a victim of Sinus or Catarrhal Infection write National Laboratories, Benj. Franklin Station, Washington, D. C.

NERVOUS? Conquer fear, worry, bashfulness! Free, special information. John Englund, Box 335A, Ironwood, Mich.

LEARN Ventriloquism, 3c stamp brings particulars. Smith, Room 801, 801 Bigelow, Peoria, Ill.

OLD Dental Plates remade with transparent life-like plastic. Free booklet. Beauti-Pink Co., Dept. 32, Union City, N.J.

PHOTOS—male or female models! Books! (Stamp). Nuart, 2041 E. 21st, Oakland, Calif.

HOLLYWOOD Beauty Secrets, five easily compounded formulas \$1. Doctor Kay, Stimson Bldg., Los Angeles, California.

150 DESCRIPTIONS, Addresses 25c. Western Agency, 708-G Hillstreet Bldg., Los Angeles.

LOWEST prices blades, Apris, X-cellos, Silvertex, Texide; many others. Free details. Star Products, Buffalo, N.Y.

1100 USES for Waste Materials. Indispensable Booklet—50c. Box 5, Hollywood, Calif.

WANT A Super-Memory? Write "CQ" Info Company, Box 1122, Chicago.

50 BEAUTIFUL Christmas Cards \$1.00. Gjolfi, 131 Chestnut, Scranton, Pa.

PHOTO FINISHING

IMMEDIATE Service! Pictures returned same day order is received. Sixteen guaranteed Deckled-edge Velox prints from roll, 25c. One colored or two plain enlargements plus 8 Deckled-edge Velox prints, 25c. Special! Coupon for 8x10 enlargement given with each 25c order. Any 36 exposure 35mm film fine-grain developed, "Magic-Eye"—timed, Vaporate Treated and each good negative enlarged to 3x4 on Deckled-edge Velox paper, only \$1.00. Reloads: 36 exposure, 50c; 18 exposure, 35c. 3x4 Deckled-edge reprints, 3c each! Details, sample, mailers, other bargains free on request. American Studios, Box 71, LaCrosse, Wis.

35mm, ARGUS, Leica, etc., (except "Mercury") 36 exposure rolls, fine grain developed (Eastman DK-20) and beautifully enlarged to 3" x 4" glossy prints, 90c. Cartridge reloaded with Eastman Plus X, 35c. 18 exposure rolls, 55c, reload 20c. Films permanently protected by revolutionary Cryolyte Process. 24-hour service. Satisfaction guaranteed. Free mailing bags, sample print. Write Technifinish Laboratory, 641-645 Brown St., Dept. 710, Rochester, N. Y.

TO 16 Prints—2 Free Enlargements. Special, get-acquainted offer: Any 6 to 16 exposure roll developed and printed with sparkling Nu-Border Lifetone prints and free DeLuxe pocket photo album, plus two beautiful Hollywood enlargements, and free Leathertone frame—only 25c each roll. Lifetone Studios, Dept. M-27, Des Moines, Iowa.

DOUBLESIZE Prints. Your roll developed and 8 doublesize prints 25c; from 116, 120, or 127 size negatives you receive 4x6 inch prints. All smaller sizes receive 3 1/4 x 4 1/2 inch prints, 16 exposure rolls 50c; 12 exposure rolls 35c. Reprints 3c each. "Our Guarantee". Everlasting Hi-gloss Finish. Overnight service. Pacific Photo Service, Box 666, San Francisco, Calif.

FINER Finishing specials 25c. 6 or 8 exposure roll developed. Your choice—16 prints or 8 prints with 2 professional enlargements or 8 prints and one colored enlargement. Genuine Moen-Tone Nationally known superior quality. Established 1899. Moen Photo Service, 200 Moen Bldg., La Crosse, Wis.

BIGGEST \$1.00 value in 35MM finishing today. 36 exposure fine grain vaporated 3 1/4 x 4 1/2 enlargements; deckled, embossed margin and date. Eighteen exposures 75c; sixteen exposure splits 55c. Free Mailers. 8 exposure rolls in beautiful, deckled contact finish with free handy album 25c. Mailbag Film Service, Box 5440A, Chicago.

8 ENLARGEMENTS and film developed, 116 size or smaller, 25c coin; enlarged prints 3c each; special offer: enclose advertisement and negative for hand-colored enlargement free with order 25c or more. Enlarge Photo, Box 791, Dept. PS, Boston, Mass.

FOR the discriminating amateur—8 exposure rolls, 2 prints each 25c. Miniature rolls enlarged 3 to 6 times, 8 exposures 25c, 16 exposures 50c, 35MM 36 exposures, 3x4 enlargements \$1.00. Unexcelled quality, prompt service. Paramount Photo, 327 E. 92nd St., New York.

40,000 SATISFIED Customers! Rolls film machine developed—no scratches or finger marks. Your choice, two professional enlargements and eight fadeproof prints or (16 prints) 25c. Many other bargain offers. **Finerfotos**, Box 898-18, Minneapolis, Minn.

36 EXPOSURE, 35mm roll developed, Vap- orated and "electric eye" enlarged to 3 1/4 x 4 1/2 on glossy deckle edge paper, only \$1.00 complete, 18 exposure rolls 60c. Satisfaction guaranteed. Free mailers and sample print. **Eastern Photo Labs.**, 1405 N. Charles St., Dept. 3, Baltimore, Md.

OIL coloring photographs a fascinating hobby or profitable business. Learn at home. Easy simplified method. Previous experience unnecessary. Send for free information and requirements. **National Art School**, 1315 Michigan, Dept. 1727, Chicago.

18 SPARKLING Lifetime Prints, 3 Holly- wood Enlargement coupon (Ivory frames free) each roll 25c. Finished 3 hours. 18 reprints 25c, 75—\$1.00. **Overnight Studio**, Albany, Wis.

ROLL developed and printed 10c, when purchasing a new roll from us. All low prices. Roll printed all double size 25c. Write for specials and free mailers. **Film Foto**, Box 357, Passaic, N. J.

FREE Book—"Secrets of Taking Better Pictures" with each order! Kodak roll developed plus 16 super-gloss, neverfade prints, all 25c. **Superlabs**, Dept. 503-S, Elroy, Wis.

ROLLS Developed—Includes Two Prints of each exposure on glossy Velox paper, 25c coin. Guaranteed **Finest Grade Work!** **The Quinn Studio**, 7808 Wade Park Ave., Cleveland, Ohio.

TWO Sets of "Deckledge" Prints with every roll finished—25c. Very finest quality. Deckledge reprints 2c each. **Brown Photo Company**, 1910-60 Emerson, Minneapolis, Minn.

ROLL developed and 8 beautiful enlarge- ments 2 to 6 times larger—deckled edge—high gloss. Any 8 exposure roll 25c coin. Reprint enlargements 3c each. **Alden Photos**, 258-C Astor Station, Boston, Mass.

ROLLS developed and 4x6 oversize glossy Velox prints 8 exposure 25c, 12 exposure 35c, 16 exposure 50c. Overnight service. **Clemet Photo Service**, 1318 W. Columbia Ave., Philadelphia, Pa.

ARTISTIC Finishing! Get acquainted of- fer; rolls printed; 15c, 35mm enlarged; 85c. Free enlargements and coupons. Box 12, **Kingsbridge Sta.**, New York City.

ROLLS developed, two prints each and two free enlargement coupons, 25c; reprints, 2c each; 100 or more, 1c. **Summers' Studio**, Unionville, Mo.

IDEAL Photos beautifully finished wide border deckle edge, 25c, roll of 8 and free enlargement. **Ideal Photos**, Box 2255, Paterson, N. J.

TWO beautiful prints from each picture on roll 25c. Twenty years of satisfied customers. **Quick Service**. **Lens Photos**, Dept. J-9, Janesville, Wis.

ONE day service. Roll developed, 8 Velox prints, 2 double weight enlargements or 16 Velox prints, 25c. **Photo Mart**, Dept. S, Milford, Conn.

ROLLS developed—25c coin. Two 5x7 double weight professional enlargements, 8 gloss deckle edge prints. **Club Photo Service**, Dept. 21, LaCrosse, Wis.

ROLL Developed, 8 brilliant fadeproof Velox prints and two professional enlargements 25c. Overnight service. **Young Photo Service**, 406-C, Albany, N. Y.

ROLL Developed—16 guaranteed prints, two coupons on enlargements, 25c. **Smart Photo**, Winona, Minn.

ROLL Developed 8 Velox prints and Free 5x7 Enlargement 25c. **Jack's Photo Shop**, Box 306, Dept. PS9, Wilmington, N.C.

20 REPRINTS 25c, 100—\$1.00. Roll devel- oped 16 prints 25c. 5x7 enlargements 10c. 3—25c. **Nordskog**, 58, Maywood, Ill.

BEAUTIFUL enlargement from each pic- ture on roll 25c. **Cut Rate Photos**, Dept. A-6, Janesville, Wis.

16 OVERSIZE Deckledged prints and two enlargements, 25c. **Owlphoto PS2**, Weath- erford, Okla.

PROMPT Service! Rolls developed, two Velox prints each negative 25c. **Hench Studios**, Harrisburg, Penna.

ROLL developed, eight beautiful profes- sional 4x6 gloss enlargements; 25c, **Crys- tal Studios**, Box 159 S. Rushford, Minn.

ROLL Developed—Three enlargement, 16 prints, 25c. **Dicks's Photo**, EG-7, Louis- ville, Ky.

PRINTING, MULTIGRAPHING, MIMEOGRAPHING, LABELS

1000 ENVELOPES, Letterheads, Billheads, Statements, Embossed Business Cards, \$1.75 each; quality service guaranteed. **Standard Printing Co.**, Fairmont, West Va.

PRINTING Small or large quantities at quantity price. Samples, price-list. **Sico- can**, 2038 Obeart, St. Louis.

PICTURE Labels—Hundred designs, 10c refundable. **Arrowprint**, PS1041 Water- bury, Conn.

200 NOTEHEADS and 100 Envelopes \$1.00 postpaid. **Benneville**, 907 W. Roosevelt, Philadelphia.

PRINTING Special 100 8 1/2 x 11 Bond Let- terheads, 100 6 3/4 Envelopes, 4 Lines, Both \$1.00. **F. C. Cramer**, Box 993, Chicago.

25 SALEBOOKS your imprint \$1.95, 500 6 3/4 envelopes 24-sub. \$1.25. **Economy Printers**, La Crosse, Wis.

THOUSAND Business cards \$1.00. Send for samples. **Eaton Press**, 10101 Main, Gard- ner, Kansas.

JOB Printing. Quick, reasonable. Samples. **Atlantic**, Box 653-B, Rock Hill, S. C.

PRINTING OUTFITS & SUPPLIES

OWN A Printing Business. Good profit in spare time. Print your own cards, sta- tionery, circulars, advertising. Junior out- fit \$8.25, Senior \$16.55. Simple rules. De- tails free. **Kelsey, Inc.**, P-8, Meriden, Conn.

PRINT at home, 10c will bring a complete catalog of presses, type and supplies. **P. Peiffer & Company**, 4 Columbia St., New- ark, N. J.

PRESSES bought, sold. What have you? List 3c. **Meigs**, 190B Cook, Meriden, Conn.

PRINT-O-PRESS Typeless Printers make and save you money. Professional Prod- ucts, 1056, Cincinnati.

NEW Type, 29c Font. Catalog Dime. Box 123W, **Jackson**, Michigan.

PROFITABLE OCCUPATIONS

\$40.00 WEEKLY, made growing mush- rooms for us, fresh, dried. **Dominion Patent** 331583, free spawn. **North Ameri- can**, 169Y Yonge, Toronto, Canada.

STANDARD Rabbit, Pet, Milton, Pa. 3 Years \$1.00, Sample dime.

RADIOS, SUPPLIES & INSTRUCTION

RADIO engineering, broadcasting, avia- tion and police radio, servicing, marine and Morse telegraphy taught thoroughly. All expenses low. Catalog free. **Dodge's Institute**, Poplar St., Valparaiso, Ind.

ANY Radio Diagram 25c. Specify manu- facturer, model. **Supreme Publications**, 3727 W. 13th, Chicago.

REVISED plans 18 Crystal Sets (4800 mile records), with "Radiobuilder"—25c. **Labo- ratories**, 1406-T 77th Ave., Oakland, Calif.

RARE COINS

FREE! Foreign Coin, banknote and large 36 page illustrated coin catalogue to ap- proval service applicants. Send 3c postage. Up to \$20 cash paid for Indian head cents. All dates wanted. **Buying list** 10c. **Tatham Coinco**, Springfield-D50, Mass.

COMMEMORATIVE 1/2s. **Columbian**, Lin- coln, Stone-Mountain, Long-Island, Cleveland, \$1.00 each. Illustrated catalogue 25c. **Norm Shultz**, Salt Lake, Utah.

WE purchase all Indianhead pennies. **Pur- chasing catalogue** 10c. **Greenwood**, 398 Broadway, New York.

LARGE United States Coin Catalogue 10c. 75 Illustrations. 3000 Quotations. **James Randall**, 341 S. Dearborn, Chicago.

RUBBER STAMPS

NONE Better Stamps, three lines 35c. **Fed- erich Co.**, B412-K, East Pittsburgh, Pa.

CUSHIONED, 2 lines 25c, 3—35c. Ours are better! **Ad-Crafts**, LaCrosse, Wis.

3 LINE Cushioned, Indexed 30c. 1000 **Busi- ness Cards** \$1. **Ace**, Pewaukee, Wis.

SCOTCH TWEEDS

SCOTCH Tweed Topcoats, \$39.95 **Bridge- mill**, Galashiels, Scotland. 653 Shatto Place, Los Angeles.

SONGWRITERS

SONGS—Song Poems Wanted. No Charge for melodies. Free examination. **Holly- wood Recording Studios**, 87L11 Preuss Sta., Los Angeles.

WANTED. Poems, to be set to music. Sub- mit for consideration. **Transcription rec- ords** made. **Rhyming Pamphlet** Free. **Keen- an's Studio**, PS, Box 2140, Bridgeport, Conn.

SONG Poems wanted. Free examination. **McNeil**, Master of Music, 510-PS South Alexandria, Los Angeles, Calif.

SONGWRITERS. Write for free booklet, profit sharing plan. **Allied Music Com- pany**, 7608 Reading, Cincinnati, Ohio.

POEMS Wanted! To be set to music. Free examination. **Recordings** made. **Vander- bilt Studio**, Box 112-B, Coney Island, N. Y.

SONGWRITERS' opportunity—Free book- let, plan. **Song Service**, 43-J Park Place, Brooklyn, N. Y.

SONG Poems Wanted. Send poem for offer. **Five Star Music Masters**, 646 Beacon Bldg., Boston.

SONGWRITERS—Write for Free Book, Plans, Information. **Variety**, Dept. 9, Salem, Ind.

SONGWRITERS wanted. Radio contest in- formation. **Greatest Eastern Songbureau**, 41PS10, Thomaston, Maine.

SONGWRITERS: Send poem for our plan and Free Rhyming Dictionary. **Richard Brothers**, 146 Woods Bldg., Chicago.

SPORTING GOODS, GUNS, FISHING TACKLE, ARCHERY

BOW and Arrow Kits: For making lemon- wood bow—Six arrows \$1.78. Postage 20c. **Construction book** 30c. **Catalogue** Free. **Archery**, 617 So. State, Chicago.

USE A "Wristloader" for fast loading of rifles and pistols. Only \$1.00. Write for big free catalog. **Merston Company, Inc.**, Glendale, Calif., Dept. B.

IMPROVE The Stock and stop the shock. "White Line" Recoil Absorbers \$2.50. Write for free catalog. **Merston Company, Inc.**, Glendale, Calif., Dept. B.

MAKE A "10" With "10-Point" Grips, only \$3.75. Write for free catalog. **Merston Company, Inc.**, Glendale, Calif., Dept. B.

HUNTING, trapping, camping equipment. Used guns. **Catalog**. **Howe**, Coopers Mills, Maine.

ARCHERY equipment; catalogue free. **Mid- West Archery**, 2209-D East 75th, Chicago.

STAMP COLLECTING

NOTICE

Readers answering ads offering *Ap- provals* receive a selection of stamps from which they may make pur- chases at prices indicated. Ten days are allowed for payment and return of undesired stamps. Otherwise ap- proval applicants become subject to Section 2350, Postal Laws & Regu- lations, 1932, providing penalties for obtaining property by false pretense.

GIANT Packet 136 All Different from Afri- ca, South America, South Sea Islands, etc. Includes Nicaragua airmail, two scarce unused United States cataloging 20c, tri- angle and animal stamps; many others. Also includes fine collection 25 different British Colonies—Charkari, Jamaica, Jo- hore, etc. and United States \$4 and \$5 high values. Total catalog price over \$4.00! Everything for only 5c to approval applicants! **Mystic Stamp Co.**, Dept. 55-A, Camden, New York.

SUPER-Wonder Packet offered containing stamps from Afghanistan (oblong), Transjordan (emir), North Borneo (buf- falo), Manchukuo (Mausoleum), Sudan (native), Sarawak (rajah), Guadeloupe (sugar refining), Costa Rica (triangle), Iraq (late king), Brunei (boating); this entire packet for only 5c to approval ap- plicants. Big illustrated lists free. **Kent Stamp Co.**, G.P.O. Box 87 (24), Brooklyn, N. Y.

SCARCE \$1.25 Hawaii Only 10c! "Down deep in the old trunk we found the time yellowed package of old Hawaiians." So we offer Hawaii No. 78, the 1894 12c blue used, cataloguing \$1.25 (selling regularly for 75c), for only 10c to approval ap- plicants. Only one to a customer. Write to- day. **Garcelon Stamp Co.**, Box 818, Calais, Maine.

50 U. S. including commemoratives, air- mails, perfgauge, approvals 10c. **Stamp Shop**, 813 Hollandbldg., St. Louis, Mo.

POSITIVELY Greatest Free Offer—latest Scott's International \$4.00 Stamp Album—covering entire World, contains 35,000 illustrated, descriptive spaces: Scott's 1942 Standard \$3.00 Catalogue "Philately's Encyclopedia"—both absolutely free to applicants for Foreign Approvals becoming customers! Plymouth, Dept. B3, Bell, Calif.

UNITED States approvals complete coverage fine quality, attractive prices. Seminole Stamps, Box 536, Coconut Grove, Florida.

STUPENDOUS Offer! Selangor (mosque) Turkey (Obelisk), Malaya (Fierocious tiger), Sarr (dead country), Poland (Swiatowit), 10 different Chile, 25 different China, 5c to approval applicants. O. Knopp, Box 1381, Bristol, Conn.

FREE! Castelloriso Catalog \$40.00 (No. 33-6)—If you buy Latin American Rarity Lot 100 different Catalog \$85.00. Price \$5.00. No Seebecks. Send postcard for Catalog numbers huge list bargains. Donald Field, Monroe, N. Y.

FINE Approvals, freshly mounted. Fast, personal service. Tell me what countries you prefer and I'll send their stamps. Milton Skinner, 306 East Fourth, Long Beach, Calif.

SEYCHELLES, Nejd, Caymans, Manchukuo, Brunei, Turks Caicos, British Solomons (Cannibaland). Everything 3c with approvals. Viking, 130-P Clinton St., Brooklyn, N. Y.

SPECIAL—Airmails—23 different, including triangles, zeppelin, Latin-America, etc. 5c to applicants for best value approvals. Continental Stamp Co., Dept. C, Sandy Hook, Conn.

101 ENTIRELY different commemoratives, \$1.00. Album condition. Guaranteed. Alex Sharp, 1217 Linwood, Kansas City, Mo.

PHILATOPIC Monthly free—forty pages. Includes Stamp Encyclopedia. Free. Write Empire Stamp, Dept. PR, Toronto, Canada.

BOLIVIA airmails, pictorials, etc. 15 different for only 20c to approval applicants. Free packet and lists included. W. T. Torgesen, West Englewood, N. J.

206 DIFFERENT stamps including Kedah, Haiti, Cochiti, Albania, Johore, Perak, only 10c to approval applicants. Reich Stamp Co., 4647 Kenmore, Chicago, Dept. S3.

CHARITIES—The hard to get stamps. 25 different, including sets; 5c with approvals. Reliable, 97 Nassau Street, New York.

SUBSCRIBE to "Hobby Spotlight", 20 page illustrated, 6x9, magazine on stamps, coins. Next three issues—25c. Arlie Slaugh, Oakland, Md.

U. S. COMMEMORATIVES, 35 different including S.P.A. Sheet, 15c with request for approvals. Empire Sales, Box 268, Springfield, Missouri.

UNITED States. Hard to get, yet inexpensive U. S. stamps in our approval books. 1500 varieties in stock. Southern Stamp Co., Box 70, Miami, Fla.

100 U.S. including complete 1/2c-\$5.00 set, 15c. Matz-5, Carmi, Ill.

10,000 VARIETIES 1c each! Gordon Davison, Box 568D, Manchester, N. H.

25 DIFFERENT New George VI issues from British Colonies in all parts of the World, 5c with approvals. Bookman, Box 145-S, Maplewood, N. J.

1000—U.S. mixed, containing old and recent commemoratives, high values, precancels, etc., 35c in coin. J. W. Dauber & Son, Bethesda, Md.

70 DIFFERENT U. S., 10c. Approvals. Kostka Bros., 20-02 45th St., Long Island City, New York.

U. S. COMMEMORATIVES 30 different 20c with approvals. Eaton's, 618-S Eaton Road, Rochester, N. Y.

WILL Rogers, Nicaragua Airpost stamps complete, 10c. V. O. Park, Clarksville, (S3) Tennessee.

LOWEST Priced Approvals. Sent Anywhere. Dowd, East Cherry, McKenzie, Tenn.

ZANZIBAR, Fiji, Nejd, Cayman, Thailand, Manchukuo, Uganda, Algeria, 5c with Approvals. Postzegel, PsI, Windham, N.Y.

50 FREE, catalogued \$1.00; approvals not obligatory. Bullard, Box 13, Winter Hill, Mass.

50 DIFFERENT U.S., many Commemoratives, 5c. Gerhardt, 2804 Rio Grande, Austin, Texas.

200 DIFFERENT U.S. (including 50 Commemoratives) \$1. Harold Blackstone, Berwyn, Pa.

PERSONAL Approval Service. Attractive low cost selections 100 mixed 3c. Turner, 3024 Vicksburg, Detroit, Mich.

UNPICKED! 100 U. S. revenues on documents — 10c! (700 — 50c.) Vanvoorheis, Hyndman, Pa.

FREE—Five beautiful Airmails, including Triangle, to approval applicants. Green and Co., Norwood, Ohio.

140 LIBERIA, Nejd, Uruguay, Selangor, Tunis, Miquelon, Etc., 10c. Lufbery, Middletown, Conn.

25 UNITED States, including \$4 & \$5 stamps free to approval applicants. 3c postage. Brownie Stamp Shop, Flint, Mich.

FREE! Western Hemisphere Packet. Postage 3c. Owens, 801 Welshbldg., Baycity, Mich.

FREE! Pony Express set (facsimiles). Postage 3c. Roberts, 401 Shearerbldg., Baycity, Mich.

87 1/2% DISCOUNT. Selection against references—adults. Dolin, 31-Q Park Row, New York.

2c BUYS 12 large pictorials, triangles, Uruguay set, etc. Approvals, F-S Co., Box 2154, Houston, Texas.

FREE! Canada Royal Visit complete with approvals. Chester, Box 545-V, Utica, N. Y.

EXCHANGE your duplicate stamps. List, swappers, dime. Registrar, Box 2166, Denver, Colorado.

1000 GRABBAGS 15c each. U.S., Foreign. Sandy, 630 Bingham, Reading, Pa.

45 DIFFERENT Peru, Brazil, Ecuador—10c. Box 6618, Northeast, Kansas City, Mo.

UNITED States Stamps, 60 different, 10c. Goldsmith, 632 S. Union, Los Angeles.

150 GOOD mixed foreign stamps, 5c coin. Stanton, Niantic, Conn.

SOUTH American—100 different 10c—with approvals. Davis, Silver Lake, Ind.

NEWFOUNDLAND special, 25 stamps 10c. Altone, 2068 Daly, Bronx, N. Y.

PENNY Black Set Free. Request approvals. Knight, Box 3780, Portland, Oregon.

PENNY Approvals that satisfy. Neil Gronberg, Box 5441S, Philadelphia, Penn.

72 DIFFERENT U. S., 10c. Approvals. Album Service, 57-10, Sioux City, Iowa.

FREE! Austria War set. Postage 3c. Williams, 601 Archerbldg., Baycity, Mich.

RARE Old Samoa Set 5c with approvals. Bailey, Pierson, Florida.

100 ALL Different U. S. 10c. Monjar, 1750 Fairmount, Cincinnati, Ohio.

STAMP Dealers—Your ad in this column will produce profitable business at low cost. Write for proof. O. K. Kelly, Dept. S-1, 353 Fourth Ave., New York, N. Y.

TATTOOING SUPPLIES

START profitable Tattooing and Removing business, free instructions. Write Tatooco, 651 S. State, Chicago.

TATTOOING Outfits, Supplies. Illustrated List Free. Percy Waters, Anniston, Ala.

TREASURE FINDERS

MT-SCOPE Metal Locator fully guaranteed and unsurpassed in efficiency. Time payment plan, trade-in and accessories. Free literature. Fisher Research Laboratory, Palo Alto, Calif.

TYPEWRITERS, OFFICE DEVICES

TYPEWRITERS, adder, mimeograph, multigraph, addressograph. Send for free lists of machines that will help you at half price. Pruitt, 23 Pruitt Bldg., Chicago.

WANTED—MISCELLANEOUS

HIGHEST Prices for used Cameras, Binoculars, Microscopes, Drawing Sets, Tools, any optical or scientific instrument. Satisfaction guaranteed. Gordon's, 162-S Madison, Chicago.

OLD Gold, Micrometers, Machinist Tools. E. M. Howell, 155 E. Wilkes-Barre, Easton, Pa.

MERCURY. Cash paid promptly. Quotations free. Mercury Terminal, Norwood, Mass.

WATCHES

WATCHMAKERS' Materials—Tools—Watches. Bought; Sold. Best prices for Old Gold, diamonds. Free Catalog. Ben Segal Company, Box 150, Chicago.

WATCHMAKERS' Tools, supplies. Watch parts. Write for price list 50. Dean Co., 116 Nassau St., New York.

WELDING, SOLDERING

D. C. Arc-Welder, Build it yourself from Automobile generators, vehicle motors, light plant generators. Plans \$1.00 each. Welders Club, WB-3432 M-Mart, Chicago. For Sale: Vehicle motors, Welding Supplies.

BARGAINS, Demonstrator arc welders, gasoline and electric drive. Build your own portable, save \$500. Liberal Trial. Easy terms. Write Hobart Welder Exchange, Box P-1012, Troy, Ohio.



BUILD 60-200 Amp. A-C welder for \$10. Several plans \$1.00. Information dime. Hi-Point Electric Products, Dept. W., Bellefontaine, Ohio.

SAVE 50% on A.C. Arc Welders—Plans. Holgerson, Canton, Kansas.

HOLD AVIATION'S BETTER *Production* JOBS

There are jobs and jobs in Aviation nowadays, most of them only routine work. The industry has an even MORE urgent need for men trained for the more important duties in aircraft production. Such positions—PREFERRED jobs—are held by many of the over 3,000 Aero I.T.I. graduates employed by over 100 aviation firms. Many more graduates are in important supervisory positions over other men. Their same training is YOUR opportunity—investigate Aero I.T.I. training and see how much more it can mean to your future... to your security and success in a lifetime career. For details, write NOW.

Inspection
Power plant
installation
Final assembly
Pre-flight
check
Experimental
—and many others

Above—Student-built plane getting pre-flight check. Right—Assembly of large, all-metal planes is part of Aero I.T.I. training.

Robert E. Gross
President, Lockheed Aircraft Corporation

John K. Northrop
President, Northrop Aircraft, Inc.

C. A. Van Dusen
Vice-Pres., Consolidated Aircraft Corporation

AERO INDUSTRIES TECHNICAL INSTITUTE
5247 WEST SAN FERNANDO ROAD, LOS ANGELES, CALIFORNIA

Five Courses in
AIRCRAFT MECHANICS and AERONAUTICAL ENGINEERING

—Including 12 Month Aircraft Mechanics Course
Approved by U. S. Civil Aeronautics Administration

FREE

Stove Catalog

Factory Prices



106 Styles and Sizes. Coal-Wood Ranges; Combination Gas-Coal or Oil Ranges; Gas Ranges; Oil Ranges; Oil Heaters; Coal-Wood Heaters; Furnaces. 30 Days Trial.

24 hr. shipments. 1,700,000 Satisfied Users. Easy Terms. \$5 Down on stoves. Factory guarantee.

KALAMAZOO STOVE & FURNACE CO., MFRS.

721 Rochester Avenue

Kalamazoo, Mich.

41 years in business

"A Kalamazoo Direct to You"

THERE'S MONEY IN

CARTOONS!

RAYE BURNS will teach you HOW to CREATE ORIGINAL CARTOONS at home that you may SELL! Course contains 26 lessons and over 600 illustrations. All for Only...

\$2.85

Send name and address for free details.

RAYE BURNS SCHOOL, Studio S, Box 3583, CLEVELAND, OHIO

Operator No. 38



FOLLOW THIS MAN

Secret Service Operator No. 38 is on the job! Running down dangerous Counterfeit Gang. Tell tale finger prints in murdered girl's room.

Free The Confidential Report Operator No. 38 made to his chief. Write for it.

Earn a Regular Monthly Salary

YOU can become a Finger Print Expert at home, in your spare time, at small cost. Write for confidential full report and details. Literature will be sent only to persons stating their age.

INSTITUTE OF APPLIED SCIENCE

1920 Sunnyside Ave. Dept. 1367 Chicago, Ill.

STUDY ENGINEERING AT HOME

Earn a Degree at Home From A Chartered Educational Institution Conducted by Correspondence

Degree Course in Electrical; Civil; Mechanical; Drafting; Architectural; Automotive; Steam; Diesel; Aeronautical; Radio; Structural; Mining; Industrial; Highway; Petroleum; Marine; Refrigeration; Air Conditioning; Chemical Engineering; Arts; Sciences; Philosophy; Education; Public Health; Medical Jurisprudence; Psychology; Sociology; Physics; Chemistry; Geology; Pol. Science; Theology; Law; Agriculture; Business Training; Accounting; Statistics. Founded 1908. Chartered McKinley-Roosevelt Foundation, 4610-BF Sheridan Road, Chicago

New Catalog

GENUINE U. S. BARGAINS

O. D. Wool Blankets (used)...\$2.19
McClellan Saddles (used)...5.95
U. S. Army Pup Tents (used)...2.50
U. S. Marine Ponchos (Used)...1.29
Thousands of other bargains in military, outdoor & sport goods for hunter, farmer, scout. Send 10c for 32 page catalog returned with first order.

A and N SUPPLY CO.

4784 LESTER ST. RICHMOND, VA. EST. 1868



Regain Perfect Speech, if you

STAMMER

Every stammerer should have the new 287 page book "Stammering, Its Cause and Correction". Sent free to stammerers. It describes the Bogue Unit Method for the scientific correction of stammering and stuttering. Method successfully used at Bogue Institute for 40 years—since 1901. Endorsed by physicians. Write for full information. No obligation. Benjamin N. Bogue, Dept. 980 Circle Tower, Indianapolis, Indiana.

AGENTS WANTED

GOLDENTONE...50% OFF



Deal Direct—Factory Prices. Over 75 models to choose from—4 to 12 tubes. Portables \$8.98 up. Farm sets \$8.98 up. Car sets \$8.98 up. Foreign band sets \$8.98 up. Samples 50% off. Quantity discounts. Free 1942 Bargain catalog gives details of 10 day FREE trial, agent's proposition and discounts. No obligation. Mail postcard to: DEPT. PS DEARBORN, MICH.



The 97 Pound Weakling

—who became "The World's Most Perfectly Developed Man"

"I'll Prove that YOU, too, can be a NEW MAN!"

Charles Atlas

I KNOW, myself, what it means to have the kind of body that people pity! Of course, you wouldn't know it to look at me now, but I was once a skinny weakling who weighed only 97 lbs.! I was ashamed to strip for sports or undress for a swim. I was such a poor specimen of physical development that I was constantly self-conscious and embarrassed. And I felt only HALF-ALIVE.

Then I discovered "Dynamic Tension". It gave me a body that won for me the title "World's Most Perfectly Developed Man."

When I say I can make you over into a man of giant power and energy, I know what I'm talking about. I've seen my new system, "Dynamic Tension," transform hundreds of weak, puny men into Atlas Champions.

Only 15 Minutes A Day

Do you want big, broad shoulders—a fine, powerful chest—biceps like steel—arms and legs rippling with muscular strength—a stomach ridged with bands of sinewy muscle—and a build you can be proud of? Then just give me the opportunity to prove that "Dynamic Tension" is what you need.

No "ifs," "ands," or "maybes." Just tell me where you want handsome, powerful muscles. Are you fat and flabby? Or skinny and gawky? Are you short-winded, peppy? Do you hold back and let others walk off with the prettiest girls, best jobs, etc.? Then write for details about "Dynamic Tension" and learn how I can make you a healthy, confident, powerful HE-MAN.

"Dynamic Tension" is an entirely NATURAL method. Only 15 minutes of your spare time daily is enough to show amazing results—and it's actually fun! "Dynamic Tension" does the work.

Send for FREE BOOK

Mail the coupon right now for full details and I'll send you my illustrated book, "Everlasting Health and Strength." Tells all about my "Dynamic Tension" method. Shows actual photos of men I've made into Atlas Champions. It's a valuable book! And it's FREE. Send for your copy today. Mail the coupon to me personally. CHARLES ATLAS, Dept. 1K, 115 East 23rd Street, New York, N. Y.



CHARLES ATLAS, Dept. 1K, 115 East 23rd St., New York, N. Y.

I want the proof that your system of "Dynamic Tension" will help make a New Man of me—give me a healthy, husky body and big muscular development. Send me your free book, "Everlasting Health and Strength."

Name..... (Please print or write plainly)

Address.....

City.....State.....

Get Into PHOTOGRAPHY



**for YOUR Biggest Opportunity
—Now and LATER!**

You're doubly-sure of your future when you're an expert photographer. For photography not only offers unusual opportunities today, but it has proved itself one of the few businesses that keep right on going ahead in both good times and bad. There's good money in it today both as a fulltime career or for sparetime earnings. As a hobby, it can be turned into CASH if ever the need should arise.

YOU Can Profit from Our 31 Years of Successful Photographic Experience

Under N.Y.I.'s tested and proved methods you "learn by doing"—with every step personally directed by experts on our full-time faculty. No classes. Start any time. Come to New York and enjoy the unexcelled facilities of the world's largest photographic school or train at home. Courses in Commercial, News, Portrait, Advertising, Motion Picture and COLOR photography. Free book gives details.

NEW YORK INSTITUTE OF PHOTOGRAPHY
Dept. 5, 10 West 33 Street, New York, N. Y.



FIX ANY RADIO

Amazing New Invention

**Simplified
Radio
Servicing
by
Comparison
Method**

Learn quickly to repair all radiosets. Revolutionary different **Comparison** method permits you to do expert work almost immediately. No previous radio knowledge needed. Find any fault quickly. Use a screw driver, pliers, and a piece of wire—no testers needed in most cases. Simple, point-to-point, picture suggestions tell you where to look for faults and how to make the repair. Covers every radio set—new and old.

**Complete
\$1
Training**

FOR BEGINNERS

Simplified introductory job sheets will tell you step-by-step how to find radio faults and make proper repairs. Use these comparison tests and large picture-diagram blueprints to fix radios in minutes instead of hours. Entire plan is stark new and will simplify servicing technique. Developed by M. N. Beltman, noted engineer, author, and radio teacher. Plan protected by U. S. Copyright.

Easy to Use

In Manual Form
Size: 8½ x 11 in.
112 pages of facts
Data on 210 Tubes
16 large blueprints
1,000 service hints

RESULTS AND SATISFACTION GUARANTEED

Take advantage of our "no-risk" free trial offer. Use this home-study, money-making radio servicing method for 10 days without any obligations. See how fast you will learn to repair all radios for fun and profit. Learn new short-cuts in radio servicing. Only then you decide to keep **Comparison Method Manual** or return it and get a cash refund. You can't lose, but you owe yourself a chance to look at this plan. Send coupon today—service radios this week.

NO-RISK ORDER COUPON

SUPREME PUBLICATIONS, 3727 W. 13th St., Chicago, Illinois
Ship the new plan, "Simplified Radio Servicing by Comparison Method," for examination. I am enclosing \$1.00, full price, and 10c for postage. I must be satisfied or you will refund my money.

Name: PS-O-S

Address:

"TEX" BENEKE

SENSATIONAL SAXOPHONIST WITH

GLENN MILLER

PLAYS A MARTIN



Take the advice of professionals like "Tex" Beneke—your favorites on records and radio—and play a Martin. Sooner than you imagine, you may be featured in some big name band, well on your way to fame and fortune. Send today for FREE photo of "Tex" Beneke and Glenn Miller.

MARTIN Band Instrument Company
Dept. P-10, Elkhart, Ind.



FIX IT YOURSELF

Save yourself a lot of expense by doing your own odd repair jobs. Get this new edition of a famous book, showing with diagrams and directions, how to fix and repair furniture, electric outlets, windows, doors, leaky pipes, floor boards, chimneys, boilers, weather proofing, painting and hundreds of other construction and repair jobs. Picture diagrams show how each job is done. Full cloth bound \$1.00.

Popular Science Monthly, Dept. 101
353 Fourth Ave. New York, N. Y.



LEARN TO WHITTLE

You'll be proud of yourself when you've acquired the knack of carving these quaint wooden figures. The Skipper Sam'l Whittling Kit contains step-by-step instructions and material for carving TWO Sea Captains. A special steel knife—sharpening stone, and paints are included. Send only \$1.50 and the complete Kit will be sent at once.

POPULAR SCIENCE MONTHLY, Dept. 101
353 Fourth Avenue New York

FALSE TEETH



Made in our modern laboratory from your mouth impression. Satisfaction or money back. **SAVE MONEY**—ORDER BY MAIL.

As low as
\$6.50
per plate

Write TODAY for full particulars. FREE impression material and illustrated folder showing our many styles of dental plates.

MARVEL DENTAL COMPANY
Dept. 50, 343 S. Dearborn St., Chicago

SEND NO MONEY

AMAZ- ING CHEAP OIL BURNER

Sweeping the Country!!

COOK and HEAT Without Coal or Wood

In Your Present Stove or Furnace—

—No Drudgery, Dirt or Ashes—Heat at SMALL COST.

OVER 40,000 SOLD

Beats any cheap burner ever gotten out for low cost, efficient performance. Burns ordinary low priced free flowing oil, without pre-generating. No small openings to clog. Regulated by Turn of Valve—as much or as little as you want. A Guarantee with each burner.

30 DAYS' TRIAL

Prove its efficiency, convenience and economical operation.

Write Immediately for **SPECIAL OFFER TO AGENTS**

**AGENTS
Salesmen
BIG MONEY**

F. Silver says: "I can dispose of 250 HEAT KINGS before this year ends." Write us now for agents' offer.



Slips Into
Any STOVE
RANGE or
FURNACE

Quick HEAT regulated
by Turn of Valve!

who will demonstrate and take orders. Write quick, be first to learn how to make REAL MONEY right now, spare or full time—mail 1c postcard today.

UNITED FACTORIES, M-761, Factory Bldg., Kansas City, Mo.

High School Course at Home

Many Finish in 2 Years

Go as rapidly as your time and abilities permit. Course equivalent to resident school work—prepares for college entrance exams. Standard H.S. texts supplied. Diploma. Credit for H. S. subjects already completed. Single subjects if desired. High school education is very important for advancement in business and industry and socially. Don't be handicapped all your life. Be a High School graduate. Start your training now. Free Bulletin on request. No obligation.

American School, Dpt. H746, Drexel at 58th, Chicago

SHIP MODEL MAKING



New book shows how to make any model. Shows the short cuts, kinks, time-saving methods of experts. Complete plans for gorgeous galleon, clipper ship, etc. Almost 100 illustrations. Full cloth bound \$1.00. Popular Science Monthly, Dept. 101A, 353 Fourth Ave., New York.

FREE WHOLESALE CATALOG

260 thrilling pages, showing over 4000 opportunities to make money. Household goods, display card items, wearing apparel, cosmetics, foods, jewelry and toys are a few of the thousands of articles shown in this exciting book for salesmen, agents and dealers. Address a postal card to address below and request a copy of this Book Of Opportunity, NOW. No charge for it.

Spors Co. 841 Rice, Le Center, Minn.



America Needs AUTO MECHANICS

Based on
Official
FACTORY
Books
Covering
ALL Cars
1935-1941
Inclusive



PRICE
ONLY \$3

Your Money Back
if not
Satisfied

The fast moving pace of the National Defense Program has created a shortage of trained Auto Mechanics. Uncle Sam's Army and Navy needs more mechanics than ever before. Now is the time to extend your knowledge of mechanics and prepare yourself! Regardless of the car you want to repair, MoToR's new Shop Manual will show you the factory-correct way to do the job! Gives official manufacturers' data needed by every mechanic for overhauling or adjusting every American automobile made since 1934. Used daily by thousands of repair shops, students and schools. Mail coupon.

**567 BIG 8 1/4 x 11 PAGES—850
PHOTOS, DRAWINGS, CHARTS, TABLES**
— Give Nearly 200,000 Vital Facts on:

Engine overhaul — Electric system — Fuel system
Cooling system — Clutch — Transmission — Universals
— Rear end — Wheels — Brakes — Front end — Shock
absorbers — Steering — Ignition — Lubrication —
Generators — Carburetors — Oil filters and hundreds
of other detailed instructions that describe the exact
how-to-do-it of such repairs.

Published by MoToR, 572 Madison Ave., New York, N.Y.
The Leading Automotive Business Magazine

SEND NO MONEY!

MoToR, Book Department, Room 2504, 572 Madison Ave., New York

Please RUSH me a copy of MoToR's 1941 Factory Shop Manual I will pay postman \$3 plus a few cents delivery charge; but it is understood that if book does not satisfy me I may return it within 7 days (and in its original condition) and have the \$3 purchase price refunded immediately (Foreign Price \$4, cash; no C. O. D. to Canada.)

NAME AGE

ADDRESS

CITY

OCCUPATION

\$100 BONUS OFFER FOR TESTING— NEW CHEAP OIL BURNER

**COOK YOUR MEALS,
HEAT YOUR HOME WITH
CHEAP FURNACE OIL**

**LIFE-TIME
GUARANTEE**

**NO MORE SHOVELING
COAL and ASHES—**

This sensational new invention fits into your present coal stove or furnace. Life-Time Guarantee against defects... New Type 'FUELIZER STARTER VAPORIZING SYSTEM' turns cheap 130

flash furnace oil, distillate, diesel and like oils into oil-gas heat. Will not clog up. One of the quickest, hottest fires known—Better cooking, baking and heating.

Sell THREE and GET YOURS FREE—New sales plan—SHOW-MANSHIP, not high pressure salesmanship, sells the NEW QUICK-HEAT OIL BURNER. 30 day money-back guarantee plus \$1.00 BONUS OFFER! Be first, send in your name today.

NORTHWEST MFG. CO., 512-M W. 5th, MITCHELL, S.D.

Make Money in Spare Time

Be a representative of Popular Science Monthly. Taking subscriptions at the new low price is easy. And you can make good money at it. Write for particulars to Popular Science Monthly, Circulation Manager, 353 Fourth Avenue, New York, Dept. 101.

BROOKLYN YMCA TRADE SCHOOL



Trade Courses, including Defense trades offered. Also two-year day Pre-Engineering courses.

Full Shop Equipment
Unexcelled Instruction
Fireproof Dormitories.

Special Privileges. **Check your interests** on coupon to receive free literature.

- ☐ Aircraft Construction
- ☐ Machinist
- ☐ Tool and Die Making
- ☐ Mechanical Pre-Engineering
- ☐ Diesel Engines
- ☐ Oil Burner
- ☐ Diesel Pre-Engineering
- ☐ Mechanical Drafting
- ☐ Auto Mechanic
- ☐ Talking Pictures
- ☐ Refrigeration
- ☐ Television and Radio Mechanic
- ☐ Architectural Drafting
- ☐ Armature Winding
- ☐ Electrical

MAIL COUPON

1123 Bedford Ave., Dept. P.S.
Brooklyn, New York City, N. Y.

Name.....

Address.....

SEE *America's* BLITZ IN ACTION!

That Uncle Sam will strike hard and fast if the need arises is clear when you see the U.S. Army's First Armored Division in action. And you can see it now at your local theatre . . . brought to the screen for the first time in color by Popular Science! You'll ride the tanks, fire the guns, go into actual combat conditions. It's an exciting, first hand view of how America will fight. Don't miss it.

**popular
science**
on-the-screen



Produced in Magnacolor by Fairbanks and Carlisle with the cooperation of the editors of Popular Science Monthly. Distributed by Paramount Pictures

America's defense is important. If this significant issue of Popular Science on-the-screen isn't scheduled at your favorite theatre, MAIL THIS COUPON TODAY!

Theatre _____

Address _____ 1041

Mail to: Popular Science on-the-screen
353 Fourth Avenue, New York, N. Y.



"WHIZZER" Bicycle Motor. Quiet, Dependable, 4-cycle 1 $\frac{3}{8}$ h.p. Bicycle structure not weakened. Center of gravity unchanged. Looks like motorcycle. Easily installed. Further information write:

WHIZZER MOTOR SALES CO.
9000 Sunset Block Los Angeles

Now \$5.95
Only

REAL ENGINE VALUE



The G. H. Q. is a miniature gasoline engine that really operates. Over 15,000 sold in the last year. Now is your chance to buy the New Improved 1941 model kit for \$5.95. ABSOLUTELY COMPLETE with coil, condenser, plug, instructions, etc. Only a screwdriver needed. For boats, planes, midget cars, etc. All parts guaranteed. Send only \$1—Shipped Collect C.O.D. same day. Send for FREE literature or 6c for Jumbo catalog and choice of free wings or aviation pin.

GHQ MOTORS, Dept. S, 40 East 21 St., New York, N.Y.

LET'S SWAP

TRADE what you have for what you want. SELL surplus items. Big exchange opportunities for hobbyists, sportsmen, photographers, farmers, mechanics, everyone. Complete coverage, U. S. and Canada. Write me for full information about unique TRADERS' SERVICE. No obligation.

UNCLE JACK'S TRADING POST • Box 1857 A • Cleveland, Ohio

CUT ME OUT

Cut me out, paste me on a postcard and mail to Popular Science Monthly, Dept. 101, 353 Fourth Ave., New York, N. Y. I'll bring you complete supplies and instructions on how to make easily several dollars a week in your spare time.

MAKE BIG MONEY at HOME! NEW INVENTION Electroplates by Brush

Now Plates
CHROMIUM
Too!

At last, plate real CHROMIUM at home! New patented invention eliminates costly equipment and big license fee formerly necessary.



New, patented invention makes possible big earnings AT HOME. Replate auto-parts—worn articles in homes, stores, hotels, restaurants, etc., with durable, sparkling, new coat of metal—with stroke of brush. Easy, simple, quick. Genuine Gold, Silver, Nickel, Cadmium, etc. Everything furnished. Outfit complete, ready for use. No shop required. Clear from \$2 to \$5 an hour in lifetime business. Small investment starts you in business. Steady repeat. Machine can pay for itself in week. Send TODAY for FREE SAMPLE and illustrated BOOKLET how you can have a life income from a business of YOUR OWN built upon satisfied customers. Act at once!

WARNER ELECTRIC COMPANY
225 N. Wabash Ave., Chicago, Ill., Dept. 122



DRAFTING

BOOKS SENT FREE!
ON APPROVAL—5 VOLUMES
BRAND NEW EDITION

For Beginners or Experts

Written so you can understand every word, by well known engineers. De Luxe modernistic, washable cloth binding, over 1600 pages, hundreds of blueprints, charts and diagrams; prepares you for a good drafting job in mechanical lines. Sent for 10 days' free use if you mail coupon immediately.

Only 15 minutes a day with these WONDER BOOKS can prepare you for a good drafting job. Drafting from simple straight lines to important complex plans. A step at a time! Built especially for beginners, for men with only grammar schooling. Drafting room practice, PLUS ENGINEERING, made easy and clear. 400 pages on tool design, over 300 pages on machine design. Includes special volume on blueprint reading with full size actual production blueprints, some 20"x30", as well as question and answer sheets.

Big Field • Big Demand • Big Pay

Competent draftsmen are urgently needed in all manufacturing lines at \$30.00 to \$75.00 a week. That's just the beginning—FOR DRAFTSMEN HAVE GOOD CHANCES FOR ADVANCEMENT. Pleasant, fascinating work, easy to learn and do. Learn quickly with these books—send coupon for a set and see for yourself.

[A year's consulting service now given to all buyers of this famous cyclopedia of drafting.]

AMERICAN TECHNICAL SOCIETY
Publishers—Home Study Courses

American Technical Society, Dept. D720, Drexel at 58th St., Chicago, Ill. Send for 10 days' trial, Brand New 5 volume set of "Drafting for Machine Trades." I will pay the delivery charges only. If I wish, I may return books in 10 days and owe you nothing, but if I decide to keep them, I will send \$2.00 after 10 days, then only \$3.00 a month until \$19.80, the total price, is paid. Send Brand New edition and include Consulting Service Certificate.

Name

Address
Please attach letter stating age, occupation, employer's name and address and that of at least one business man as a reference.



New 64 Page Full-Color LIONEL CATALOG

Pictures of the most amazing fleet of trains Lionel has ever rolled out on the rails! Send for catalog.

FREE

LIONEL Dept. E, 15 East 26th Street, New York
Please send me at once a free copy of the new 64 page full-color Lionel Catalog.

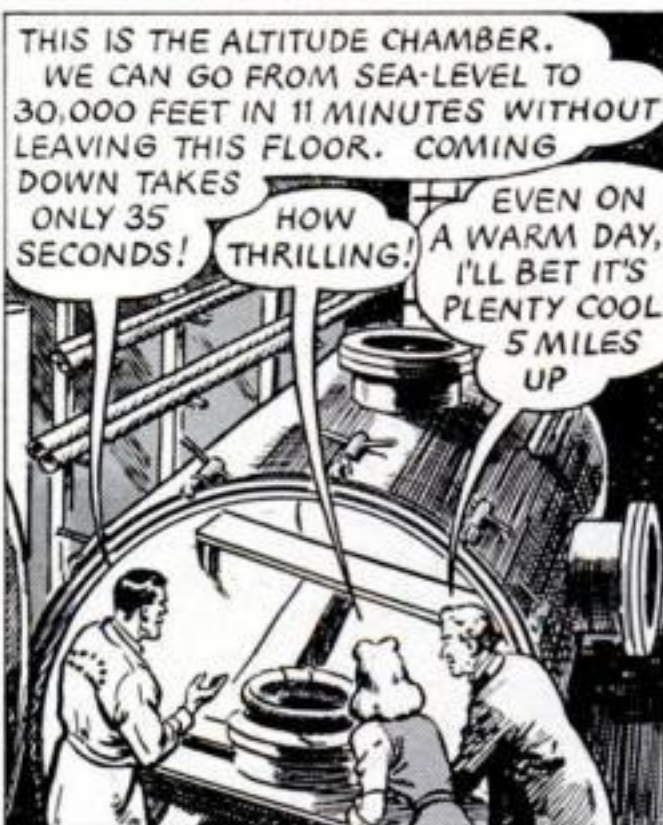
Name

Address

City State

WONDERS OF AMERICA

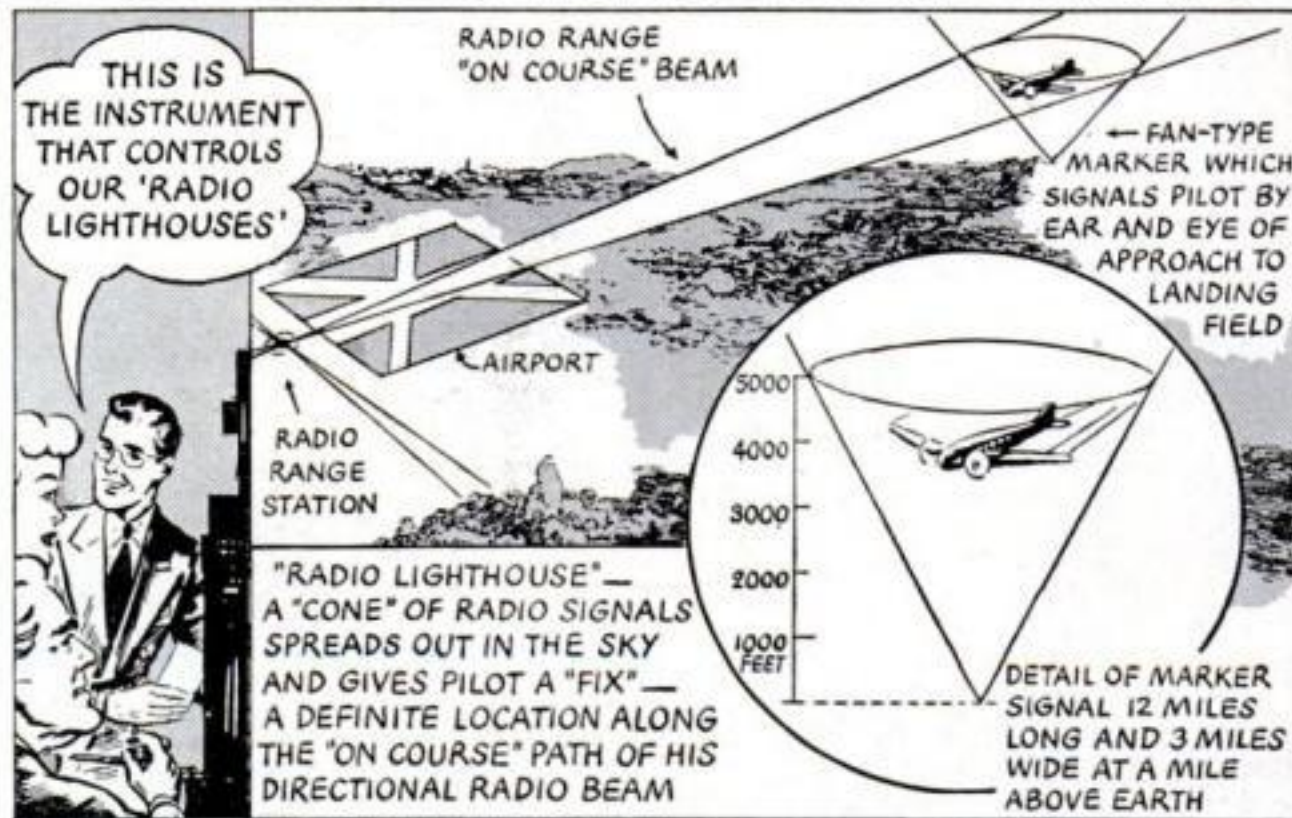
Wingless Flight



IN RECENT LABORATORY "SMOKING BOWL" TESTS, PRINCE ALBERT BURNED

86 DEGREES COOLER

THAN THE AVERAGE OF THE 30 OTHER OF THE LARGEST-SELLING BRANDS TESTED—**COOLEST OF ALL!**



50
PIPEFULS
OF FRAGRANT
TOBACCO IN
EVERY HANDY
POCKET TIN OF
PRINCE
ALBERT

R. J. Reynolds
Tobacco Co.,
Winston-Salem,
N. C.



PRINCE ALBERT

THE NATIONAL JOY SMOKE

An employee at the flag and sail loft of the New York Navy yard, Brooklyn, N. Y., at work on a battalion artillery flag. The anchor, emblem of the Navy, appears on many flags made for our sea forces



Flags for Our Navy

Busy Loft at Brooklyn Yard Keeps Fleet's Colors Flying

KEEPING its growing fleet of ships supplied with the proper flags and pennants is just one of the jobs that is keeping the Navy busy these days. It's a bigger job than you might suspect, for the Navy needs hundreds of thousands of flags a year, and much of the work that goes into them must be done by hand, even in this age of machines.

If all the flags were of one kind, the job would be a lot easier than it is. But Navy vessels, in addition to American flags, or

ensigns, as they are known in the Navy, and commission pennants, must have a number of complete sets of alphabet and numeral flags for signaling, flags to show when church services are being held aboard, flags to indicate the rank and command of flag officers aboard, and countless others. Any ship visiting a foreign country must be prepared to fly the national ensign of that country when in port. Altogether, the Navy flag makers must make more than 200 different flags.

The more commonly used flags, such as the ensign, have to be replaced frequently, too, because in windy weather or when doing duty on speedy craft such as destroyers or torpedo boats, they may be whipped to



Placing the stars in the union. Stars are cut from white wool bunting by a stamping machine that punches out 50 at a time, and pasted on the field to be held in place for stitching

Completed unions are stitched to assembled stripes as shown at the left, below. Then the canvas bindings, halyards, hooks, and other fittings go on. For efficiency, each worker performs only one operation on each flag, then passes it on to the next in line

pieces in a few weeks. Back in the days of peace and the depression, the Navy used to repair some of its less battered ensigns, but now there's no time for that, and worn-out ones are discarded.

Most of the Navy flags come from the flag and sail loft of the New York Navy Yard, in Brooklyn, N. Y., which is the largest loft of its kind in the world. Right now it has close to 475 women working in three eight-hour shifts every day and turning out more than 3,000 flags a week. The Navy's other sources of flag supply are lofts in the yards at Mare Island, San Francisco, and Cavite, Philippine Islands.

More ensigns than any other kind of flag are made at the New York yard, because the demand for them is greatest. These range from two feet to as much as 36 feet in length, though only a few of the latter size have ever been made.

With the aid of special sewing machines, average-size ensigns can be turned out at the rate of 30 or 40 an hour. To simplify their manufacture, the work is broken down so that one person performs only one operation on each flag, and then passes it along to someone else.

Red and white wool bunting is laid out on a 50-foot-long table, sometimes as much as 50 layers of it, and cut into strips for the stripes with electrically driven rotary



knives. These are then sewed together with a double-folded seam so that there is no danger of the seam ripping or leaving exposed edges which might fray in the wind.

Stars for the "union" of the ensign are cut from white wool bunting with a stamping machine which punches out 50 stars at a clip. These are pasted on each side of the blue field to hold them in place while they are stitched on. Union and stripes are then sewed together, canvas bindings, halyards, and hooks are fastened to the staff side in a single operation and the flag is complete.

Throughout the operation, in accordance with Navy regulations which state that no U. S. ensign shall be allowed to drag on the deck, floor, or ground, the flags are kept off the floor. If they are so big that they cannot be kept on the sewing-machine table while they are being made, paper is spread on the floor to catch the folds that fall.

One flag which does not have to be made often is that of the President of the United States. When there is a call for one, however, it takes a skilled worker two full weeks to turn it out. The flag is a square blue field with a yellow-tasselled border, four white stars in the corners, and the President's seal embroidered in the center. Part of the design of the seal is embroidered with a special sewing machine, but the more intricate parts must be made by hand. The flag is made of silk instead of bunting, and consequently wears much longer. Silk is used as well for special flags of cabinet officers and high-ranking Navy officers.

Probably the easiest flags to make are the international code flags and pennants. Most of these are combinations of two colors, and the flags representing the letters of the alphabet are just a bit longer than they are high, while the numerals are all long, tapered pennants.

Even here, however, it would be possible to stitch the pieces together wrong. In the

Stripes cut by electrically driven rotary knives from as many as 50 layers of cloth at a time are sewn together with a double-folded seam. In all the operations at the Brooklyn loft, care is taken to see that the national ensign never touches the floor

letter H, for instance, which is two vertical stripes, one white and one red, the white stripe must always be placed so that it will be next to the staff when it is hoisted. In the letter Y, made of alternate diagonal stripes of red and yellow, the upper corner at the staff side must be yellow, and the stripes must run upwards from the staff to the opposite side. To prevent mistakes in making these flags, copies of them are painted on the walls of the loft, together with various Navy signal flags denoting formations, maneuvers, and courses.

When the flagmakers are not busy stitching bunting or silk for flags, they are put to work making boat cloths, to drape over the seats of small boats and keep the officers' uniforms clean; green wool covers for the tables in the wardrooms; upholstery for officers' quarters; curtains, and occasionally even pillow cases.

Not long ago the flag and sailmakers loft had to be moved to a larger building, because there wasn't room enough in the old quarters. Now the Navy Yard officials are looking around for still more room. A two-ocean Navy is going to use just about twice as many flags as a one-ocean fleet, and it looks as though the Navy flag makers are going to have their hands full for some time to come.





Leaping Lena Joins the Army

All Branches of the Service Find Jobs for
the Versatile Quarter-Ton Liaison Truck,
a Car of Unlimited Possibilities in War

By DAVID M. STEARNS

HERE'S a new piece of Army rolling stock that has most of the soldiers, from privates to generals, in a fever of enthusiasm. It's officially known as a quarter-ton reconnaissance truck, and the enthusiasm arises from the fact that even though it is the smallest, four-wheeled, self-propelled vehicle the Quartermaster Corps has purchased for the Army in large numbers, it can do more things than Army officials or manufacturers expected it to do.

When the first of these small cars was delivered to the Army about a year ago, nobody was quite sure just what it could do, or what it could be used for. But after a year of experimenting it is proving itself the most versatile buggy since the development of the chariot and new uses are still being

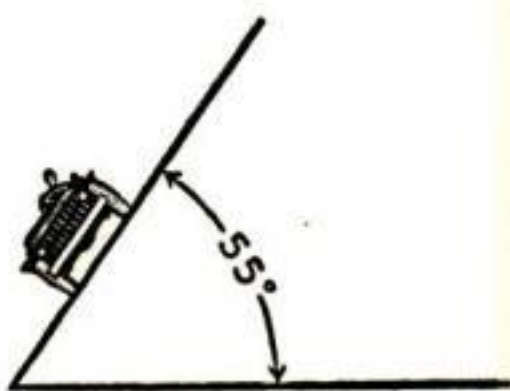
found for it in our complex war machine.

The artillery, the cavalry, the infantry, every branch of the service is adapting them to its particular needs. Already they are being used for reconnaissance work, as messenger vehicles, as prime movers for anti-tank guns, as personnel carriers, as light supply vehicles for front-line units. Their speed and maneuverability enable them to scoot for cover like jackrabbits when the need arises, and they can travel across-country like mountain goats. One cavalry unit has found that by using the gasoline tins used to supply vehicles in the field, they can make a raft which will carry a quarter-ton truck and which the truck can propel itself by means of a portable paddle wheel hooked up to one of the truck's rear wheels.

Stories and pictures of these amazing wagons have been showing up everywhere,



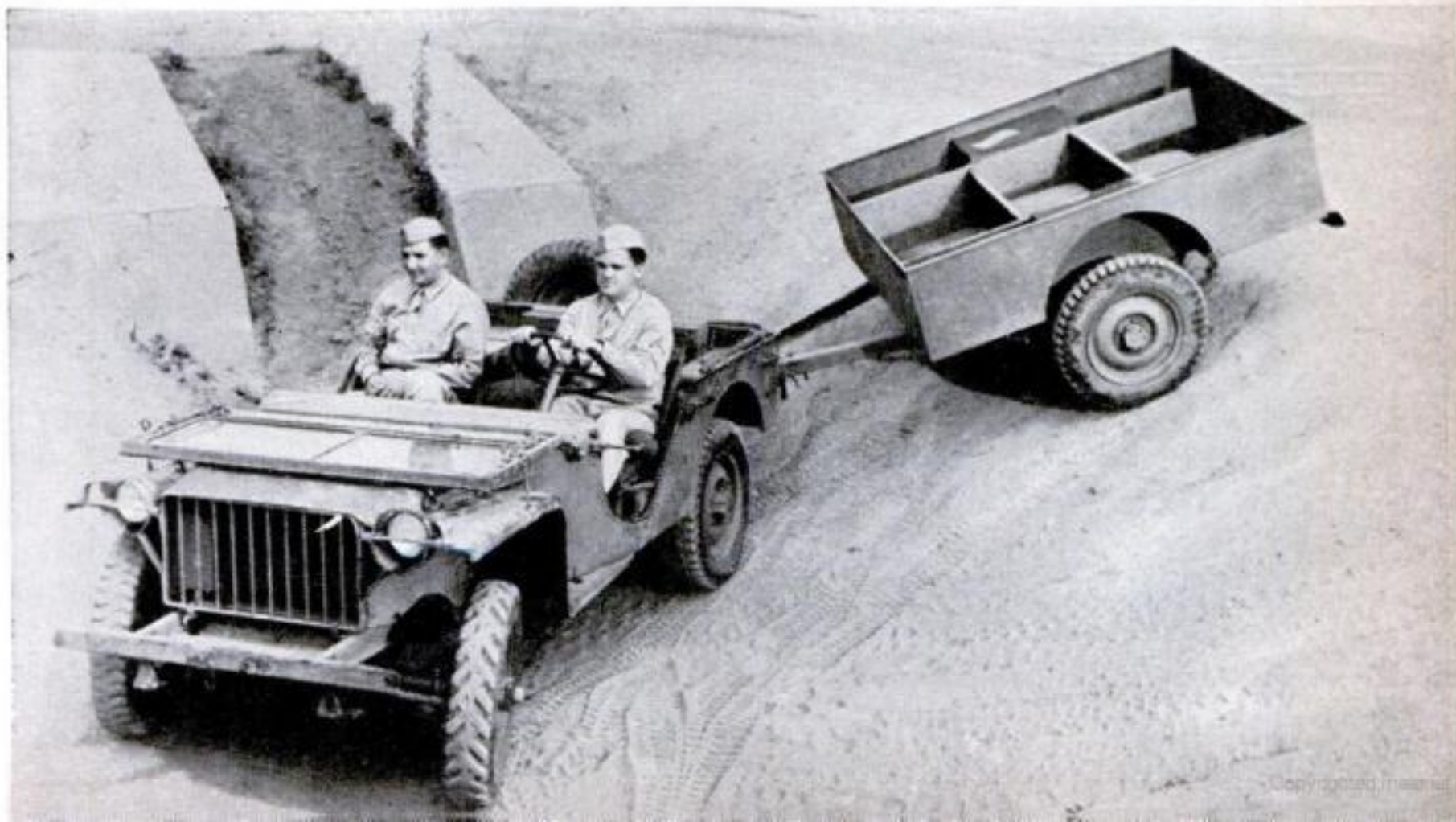
Climbing a 65-percent grade is one of the things a "bug" has to be able to do to get into the Army. The slope in the photograph is not that steep, but it is a tough climb because it happens to be a sand hill



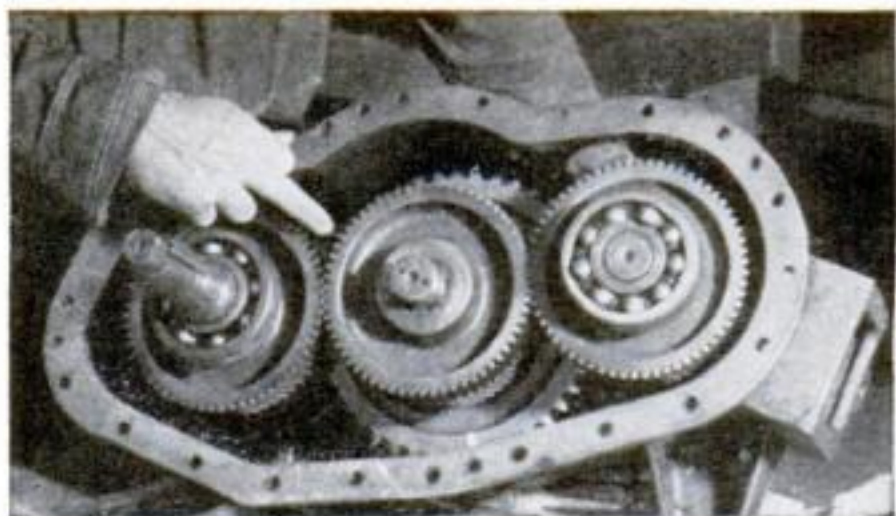
Besides carrying an 800-pound load, the midget car can tow a half ton in the form of a trailer full of supplies or a 37-mm. antitank gun on a two-wheeled mount. Trailers like the one below are attached to the bantam's body by means of a pintle hook which allows the trailer to swing wide on turns and not cramp driving style



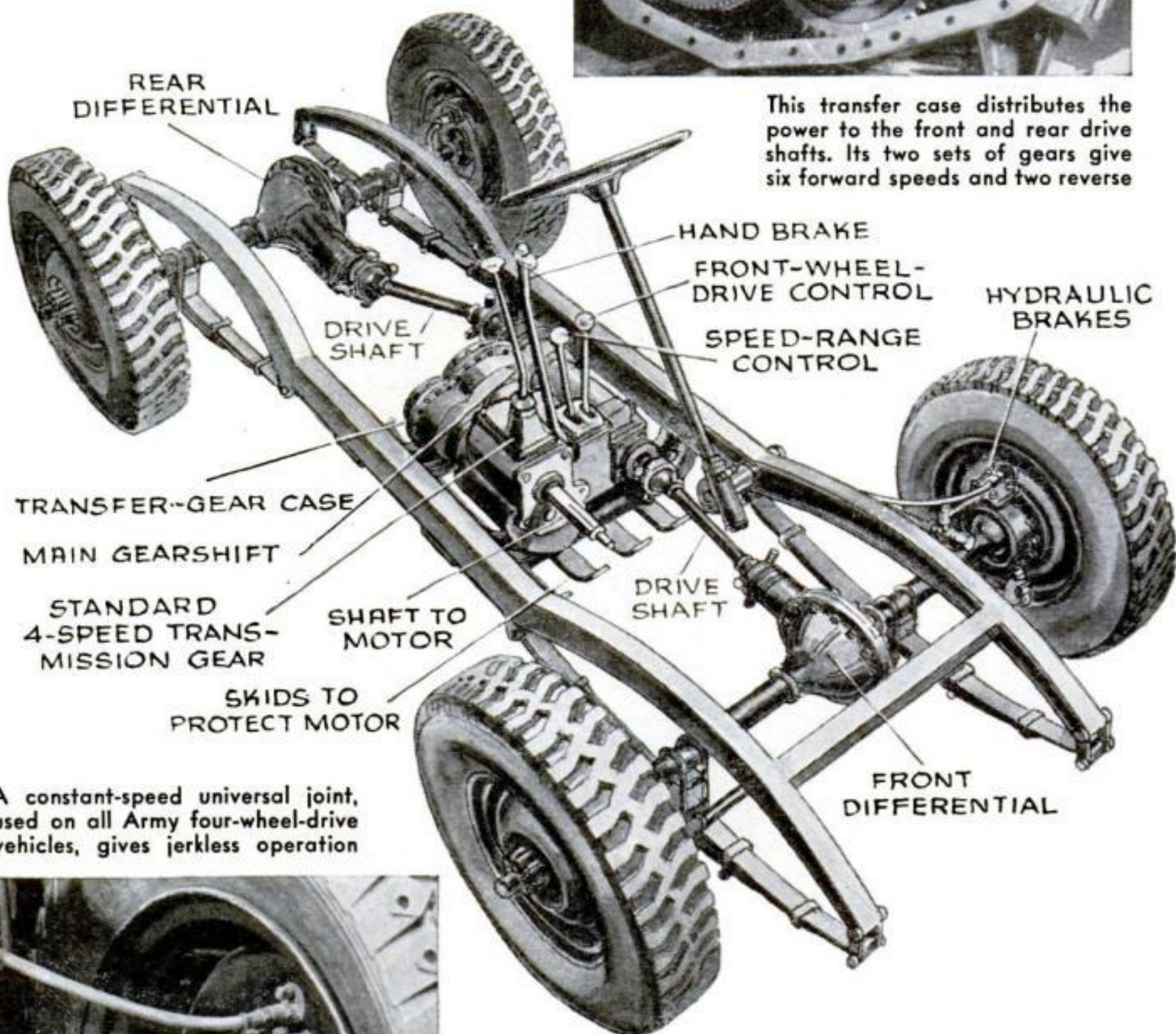
Important in rough terrain is the low center of gravity. The cars can be tipped to an angle of 55 degrees with safety



MECHANICAL FEATURES THAT GIVE THE "BUG" THE POWER TO PERFORM ITS REMARKABLE FEATS



This transfer case distributes the power to the front and rear drive shafts. Its two sets of gears give six forward speeds and two reverse



REAR
DIFFERENTIAL

HAND BRAKE

FRONT-WHEEL-
DRIVE CONTROL

HYDRAULIC
BRAKES

SPEED-RANGE
CONTROL

DRIVE /
SHAFT

TRANSFER-GEAR CASE

MAIN GEARSHIFT

STANDARD
4-SPEED TRANS-
MISSION GEAR

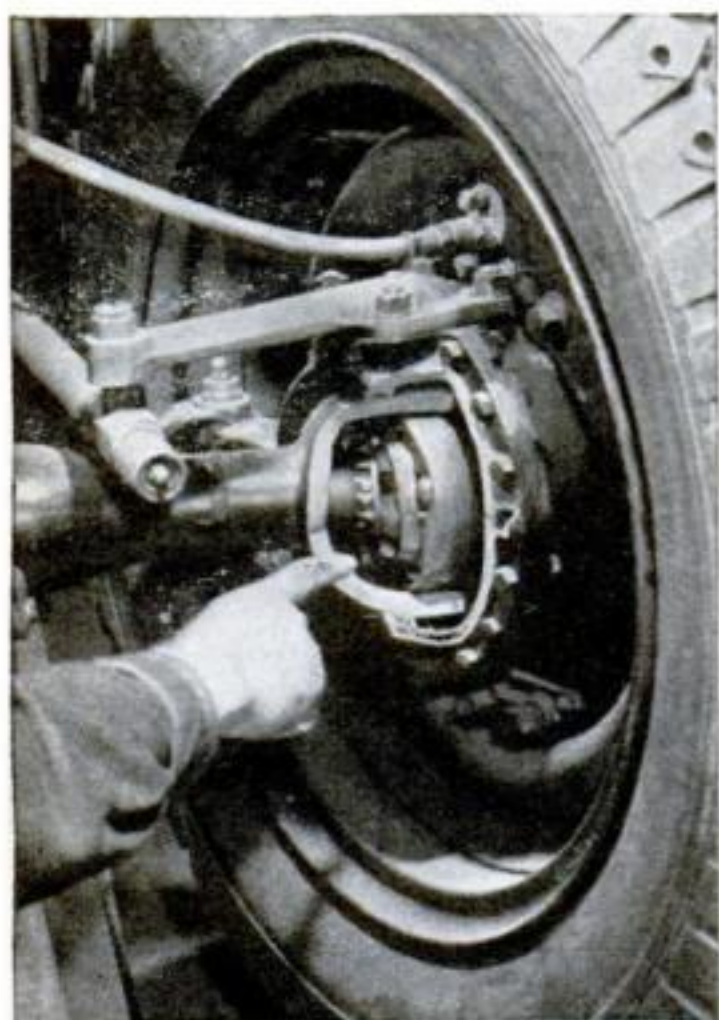
SHAFT TO
MOTOR

DRIVE
SHAFT

SKIDS TO
PROTECT MOTOR

FRONT
DIFFERENTIAL

A constant-speed universal joint, used on all Army four-wheel-drive vehicles, gives jerkless operation



but few of them tell just what goes into these mighty midgets, what makes them tick and gives them the "oomph" that is making so many converts among the Army men, notoriously a pretty skeptical crowd.

In spite of their spectacular performance, these cars are in many ways similar to your family jalopy. Steering wheels, brake and clutch pedals, instruments, starter and throttle controls, are all of standard make, similar to those found on commercial cars. Tires are 5.50 by 16, or 6.00 by 16, standard commercial sizes, though made with a special tread. Any competent pleasure or commercial-car driver can step into one and drive it without any trouble.

Windshields can be raised or lowered, and locked securely for taking the bumps



With its windshield up and the tarpaulin top in place, the car makes its closest approach to luxury. While it is by no means a real shelter, the top is better than nothing in a pouring rain



This bracket is the only support needed for the top. When not in use, it is fastened in the rear of the body with the same bolts that hold it erect



The tarpaulin is quickly stretched over the bracket and snapped to the top of the windshield and the rear of the body. Folded, the tarp stows compactly

They have been manufactured principally by three companies—Ford, Bantam, and Willys-Overland. Basically all of the bugs are alike, though the products of the various companies differ in minor details, such as type of shift lever, horsepower of engine, location of headlights, and location and type of emergency-brake controls.

The one thing that all bugs have in common, and the thing that makes them able to do such amazing things, is a selective four-wheel drive, hooked up to a power train that gives them six forward speeds and two reverse.

Power plants are conventional L-head,

four-cylinder engines, ranging from more than 60 horsepower in the Willys (basically the same engine that is used in Willys cars) down to about 45 in the Bantam, which is powered with a Continental engine. The Fords have a tractor engine.

All the engines have full force-feed lubrication systems. They have to have that because they may be required to keep running when the car is climbing a 65-percent grade (about twice as steep as any highway grade you will ever encounter) or running on a side hill, where any other lubrication system might result in burned-out bearings. Incidentally, these cars can be tipped on their

sides to a 55-degree angle before they will capsize.

Oil filler pipes, distributors, generators, batteries, and other electrical units are placed as near the top of the engine as possible so that the bugs can ford streams with water over the floor boards without stopping the engines. All the bugs are equipped with oversize oil filters and air cleaners to strain out the dust—an important consideration in view of the clouds of sand and dust in which they are likely to have to operate.

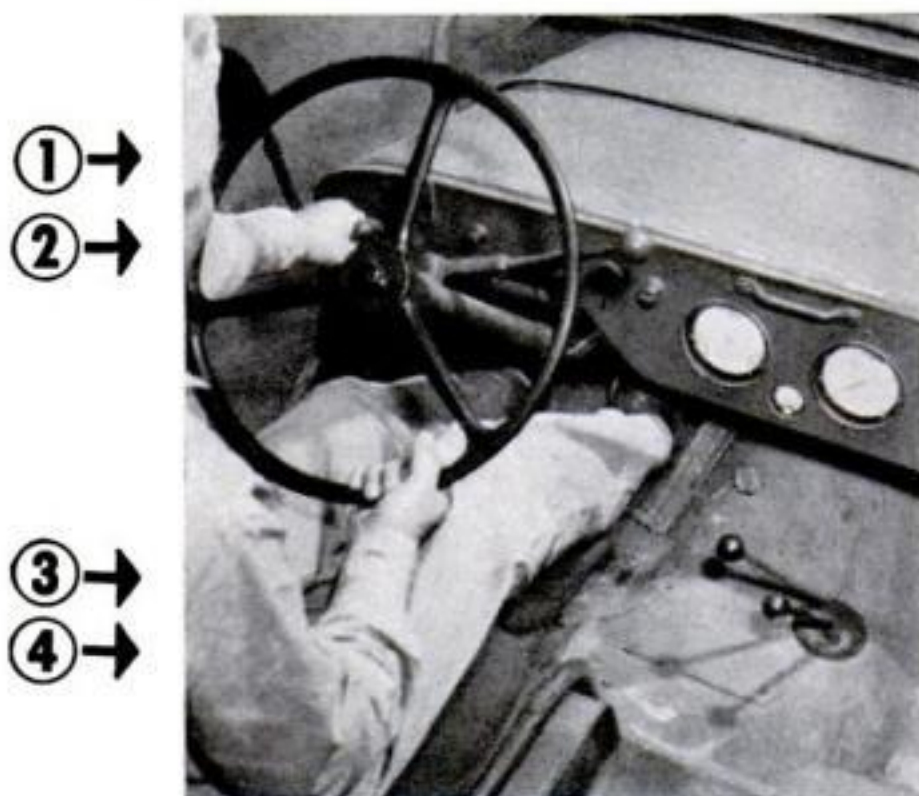
Power from the engines goes through a standard-type transmission, with a regular H-pattern shift (reverse and low on the left, second and high on the right). Fords and Bantams have shift levers in the floor, while Willys put theirs on the steering post.

From the transmission the power goes through a transfer case, a gear box which has drive shafts leading fore and aft to provide for the four-wheel drive. It also has two sets of gears, controlled by means of a lever in the floor beside the driver's seat. These are what give the vehicle its eight speeds. In the low range, used for heavy pulling, with speeds running from a few miles an hour in low, even with the engine wide out, up to 25 or better in high, the entire four positions in the transmission can be selected.

Moving the lever forward shifts the transfer case into its high range, in which the transmission can again be used in all four steps, with speeds in each case about double what they are in low range. A bug, in high range, can really travel. Though the rated top speed, which the Army boys are supposed to observe to lengthen the life of the vehicle, is only 55 miles an hour in upper high, they have on more than one occasion done much more than this, and they are officially good for 15 m.p.h. in reverse. They can better 30 m.p.h. in high range intermediate.

In the floor of the car, beside the transfer case control, is a lever which controls the front-wheel drive. This can be locked in for heavy going, or cut out for high-speed work on the highways. Because the low gear range transmits so much power that it might twist the rear driving axles and shaft like wet noodles if all the power went into a two-wheel drive, there is a lock which prevents the driver from shifting the transfer case into low range until the front-wheel drive is locked in. That spreads the power to all four wheels.

That front-wheel drive embodies one of the important units used in practically all Army vehicles, a unit on which Quarter-

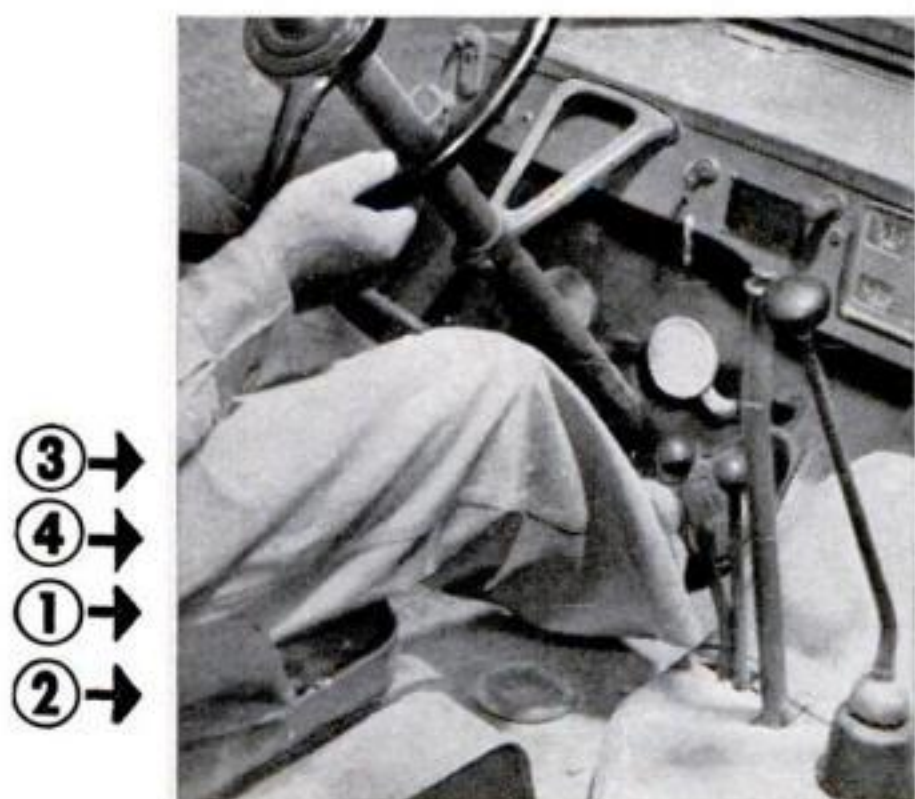
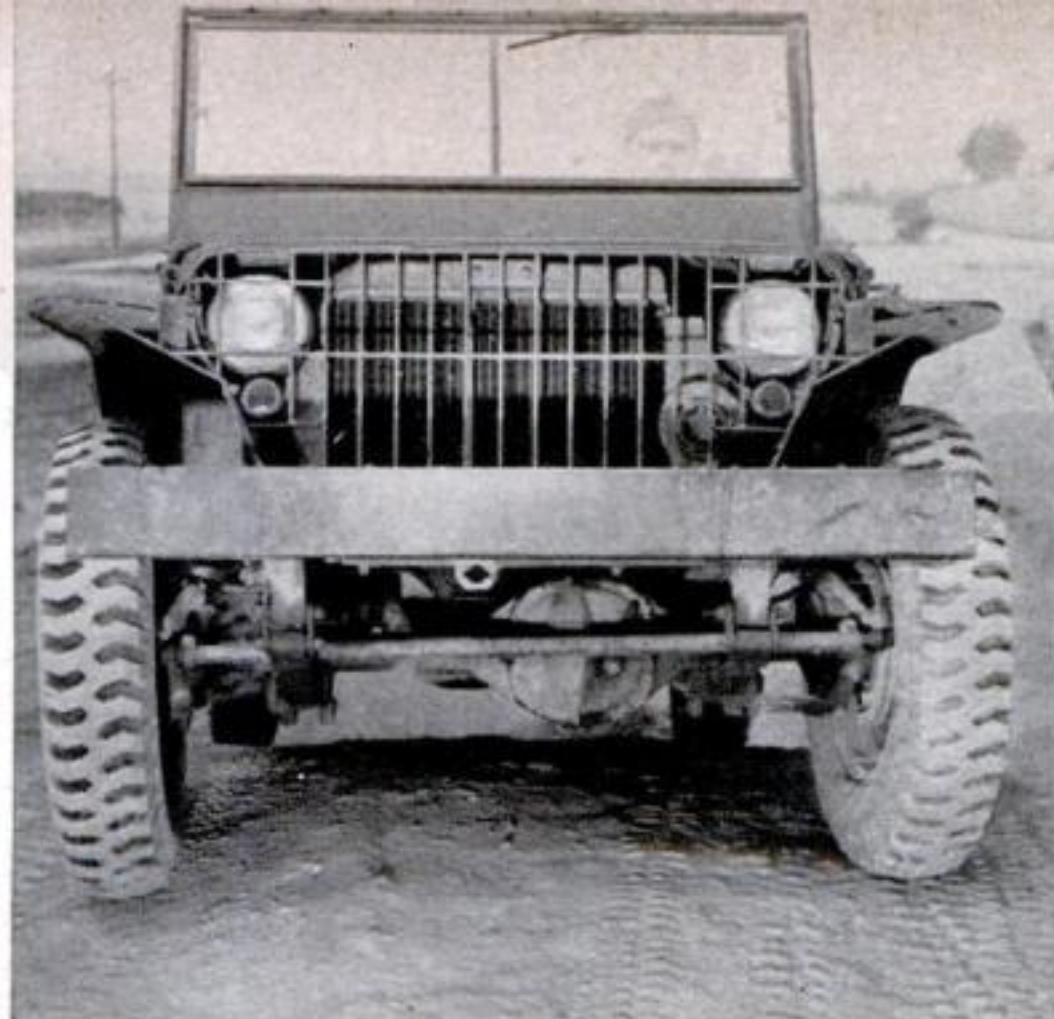


Three different makes show minor variations in controls. The Willys, shown here, has the emergency-brake handle (1) on the dash, the gearshift lever (2) on the steering post. On the floor are levers (3) and (4) for front-wheel drive and transfer gears

master Corps and commercial engineers worked for years before it reached its present stage of perfection. It is the combined driving and steering joint with which the front wheels are mounted on the axle housing.

Before it was developed, the universal joints used in front wheels imparted a jerky motion to the wheels when they were cramped one way or the other, causing excessive wear and loss of power. The new unit, which uses a series of balls operating in curved races to transmit the power to the wheels, permits the wheels to be cramped 30 degrees to either side, and used in any position in between without appreciable jerks or loss of power.

One thing the Army learned about its quarter-tons when it began to use them in

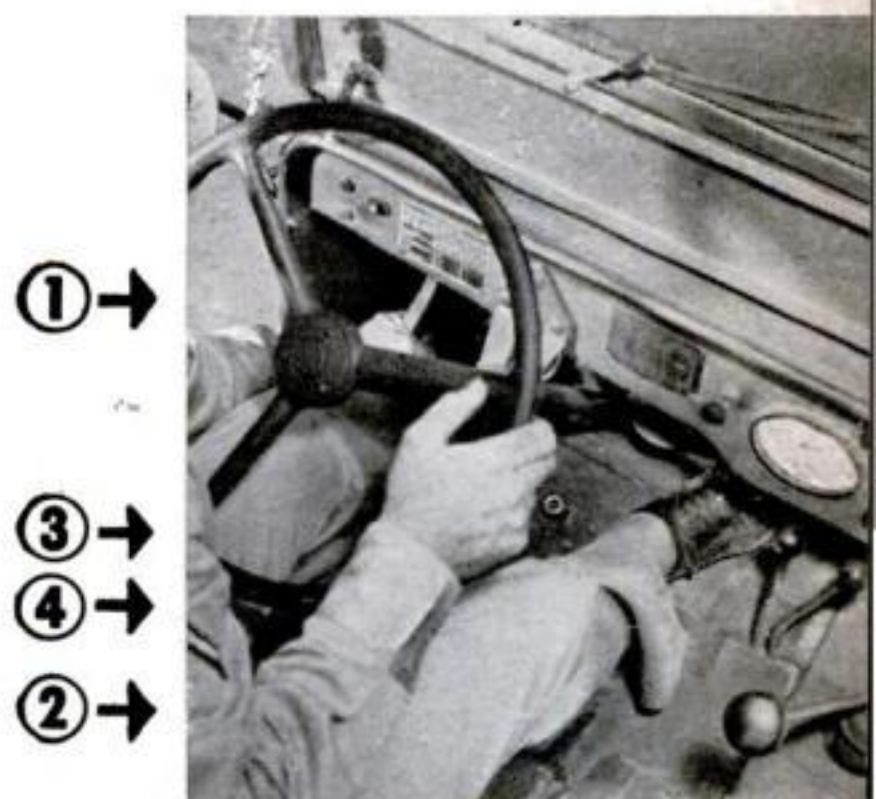


In the Ford, the headlights are shielded under the top of the hood. Both the emergency-brake and the gearshift lever are mounted on the floor as in old-style automobiles. Front-wheel-drive and transfer-gear levers are on the floor, as with the Willys

rough cross-country work was that hydraulic-brake tubes, leading from the master cylinder to the wheels, were plenty vulnerable to underbrush and other obstructions unless they were protected. Now they have worked out a system of leading the tubing along the rear sides of the differentials, fastened securely to them, so that it can't be caught and ripped out.

Another thing learned through experience in the field was that the trucks' folding windshields just weren't going to stay put unless they were securely fastened. Now they have hooks on the sides of the hood to fasten them down when they are used in that position, and more hooks to fasten them in place when they are up.

The official name for the trucks, "quarter-



This is the Bantam. This time the emergency-brake lever is under the dash and the gearshift on the floor. The two other controls have about the same position on all three cars. The differences don't bother the drivers any more than in regular cars

ton," vehicles, is a bit misleading. Actually, the first ones built were designed to carry just about that weight—500 pounds. But since then they have been improved so that they can carry 800 pounds, and in addition tow a 1,000-pound load, which is roughly the weight of the 37-mm. antitank gun which they pull.

If desirable, it is possible to bolt a machine-gun mount to the floor of the body between the two front seats. With a .30 or .50 caliber gun mounted there, and a crew of three men, they can be used for patrolling or reconnaissance work. With their wheelbase of only 84 inches, a good three feet less than the average car, they can be maneuvered almost anywhere. They make excellent units for liaison work, because they

travel fast, and don't need paved roads on which to do it. Some of the trucks, in experiments to improve their already excellent maneuverability, have been built with a four-wheel steering arrangement and a four-wheel drive.

There's a story in the Army to the effect that a lot of capable officers are quite chagrined these days, because when the Bantam company began trying to sell the Army on the idea of a flock of miniature trucks, they didn't like it. Finally, however, the idea got to the ears of somebody near the top, and he said it was worth a try at least. So an order was placed for 70 of them, a little over a year ago.

The first model turned out set something of a record. Within 49 days from the time the contract was signed for that order, the



Straps across the door openings give riders something to hold onto as they take sharp corners or side slopes

first, or pilot model, was delivered to the Holabird Quartermaster Depot, Baltimore, Md., for testing. So it is easy to understand why, while all the Army is enthusiastic about its new all-purpose car, the bug is the special pride and joy of the Quartermaster Corps, which was directly responsible for the design and testing of the new vehicle. It's the Army's car-of-all-work, but Quartermaster Corps' baby.

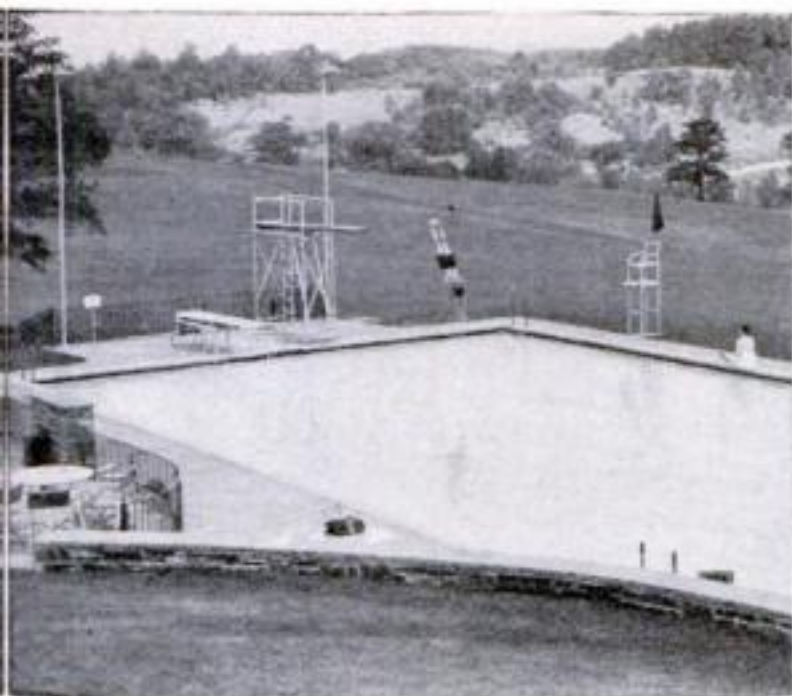
It's a safe bet that you will be seeing more and more of them doing service for the Army in the near future. And if the

time comes that the Army doesn't need all the production of the automobile factories, it's extremely likely that many of the things learned by the manufacturers in constructing these versatile vehicles will help them to make your family automobile a better car.



For rough going like this, where the humps might damage the running gear underneath, delicate spots are guarded by steel plates and bars. Corrugated steel shields exposed flooring to protect the feet of riders. Handles bolted to the side of the body, as shown at the right, give the crew members something to grab hold of if the car gets bogged down too far





Grinding pigment in a miniature mill, at right, to make rubber paint for tests of durability. Above, an outdoor swimming pool painted with rubber, and, below, an attractive rumpus room with this finish on its floor



Rubber Paint

GIVES A LASTING FINISH ON CONCRETE WALLS

By **BARRETT MCGURN**

PAIN'T manufacturers, who have been experimenting for the past five years with chlorinated rubber as a new base, believe that at last they have an answer to the tantalizing problem of painting cellar walls and floors and other concrete surfaces.

Oil-base paints—and most paints are of that type—are notorious for frequent fail-

ures on concrete bases, particularly in basements. Many an effort to turn a cellar into a rumpus room has ended in despair because the attractive paint job on the wall got bubbly and soapy. The paint cracked, peeled, and washed away, and the floor added to the intended host's misery by getting as skiddy as a slice of cheese.

What happened was that a simple chemical reaction had taken place. The walls and

floor felt soapy because they *were* soapy. A reaction had occurred between free alkali in the concrete and oil in the oil paint, forming ordinary soap. This is known technically as saponification. Moisture got in under the paint, and carried the alkali up to the paint film, where it met the oil. Failure of the paint followed.

Leaving oil out of the formula, and substituting chlorinated rubber for it, makes saponification a chemical impossibility. You can't make soap out of chlorinated rubber, and neither can the most perverse of cellar walls. As a result, the paint lasts.

The rubber-base paint manufacturers say that their paints will give basement concrete an enduring finish in a variety of bright colors. That goes for exterior stucco, too, for brick, cement, plaster, and asbestos-cement board, and for garden walls, pools, and fountains. So say the manufacturers, and they have an impressive list of case histories to prove it.

Chlorinated rubber for paint is a product of the Hercules Powder Company of Wilmington, Del., which also makes explosives. The chlorinated rubber, known in this country as parlon, is concocted in a white powdery form. Hercules makes no paint itself. It just sells the parlon to independent paint manufacturers, who in turn make it up according to their own formulas. There are well over 100 parlon paints now, each with characteristics designed to fit different circumstances.

Besides being alkali-resistant, parlon paints are in varying degrees resistant to acids, water, and mold. The latter quality may seem remote to the average householder, but it is of acute importance in bakeries, breweries, pickle works, and food plants. Mold is a major headache in such places.

Parlon was invented in Germany about the time of the last war, and called *tornsit*, a name by which it was known for years in this country. Germans still call it that. After

a plant was erected to manufacture it in Parlin, N. J., the American manufacturers renamed it for the Jersey town, with a one-vowel variation.

The first step in making parlon is to tap a rubber tree for the watery sap called latex, which is boiled down to remove excess water. Crepe rubber, sometimes called smoke rubber, remains. This is the material used as soles on some sneakers. It is placed in a solvent—some coal-tar derivative such as toluene—and chlorine is bubbled through in gas form. The chlorine forms a compound with the rubber, becoming from 66 to 68 percent of the final powder. The solvent is then evaporated, condensed, and recovered for a repetition of the operation on successive batches of rubber and chlorine, and the compound is taken out and ground down to parlon powder.

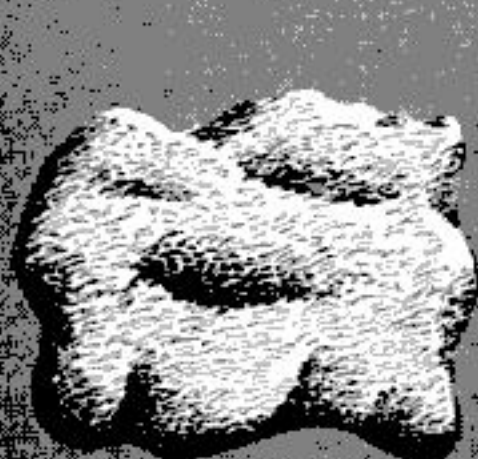
By itself parlon is practically useless. But in paint, since it eliminates the use of oil, it makes a variety of remarkable results possible.

It is used as a mold preventive, for instance. Bakeries have proof rooms in which bread loaves are placed to rise before baking. The natural processes in the bread cause black mold spores to break out on walls coated conventionally with paints containing a vegetable oil base. Such oils are nutrient; they support the growth of mold spores, and these tiny fungi finish by destroying the paint. The mold becomes a decided menace to the food being prepared, too. In spaghetti plants, mold has been known to race through an entire room in a night.

First-class bakeries have made it a practice to wash proof rooms every few weeks. In summer they repaint as often as once a month. Parlon-base paints, however, have cut these periodic paintings down from eight or ten times a year to once or twice, because they not only do not support the growth of mold, but seem even to have a fungicidal action.

As a test, panels have been painted half

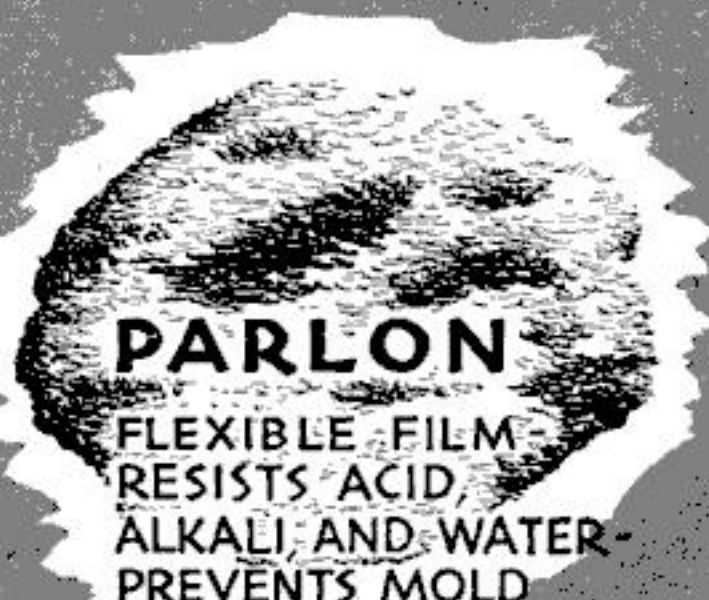
PARLON SUBSTITUTED FOR OIL MAKES RUBBER-BASE PAINTS



RUBBER



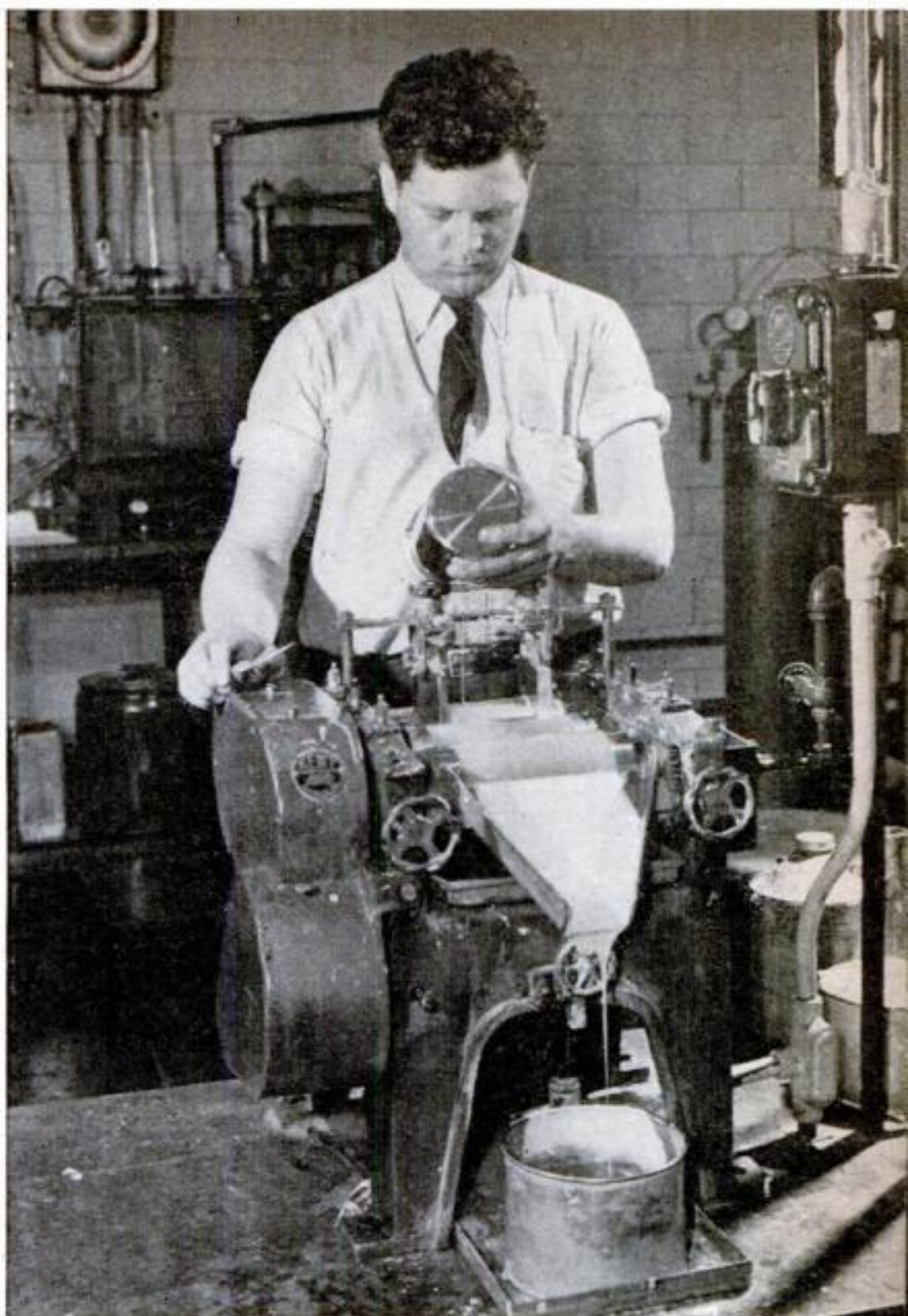
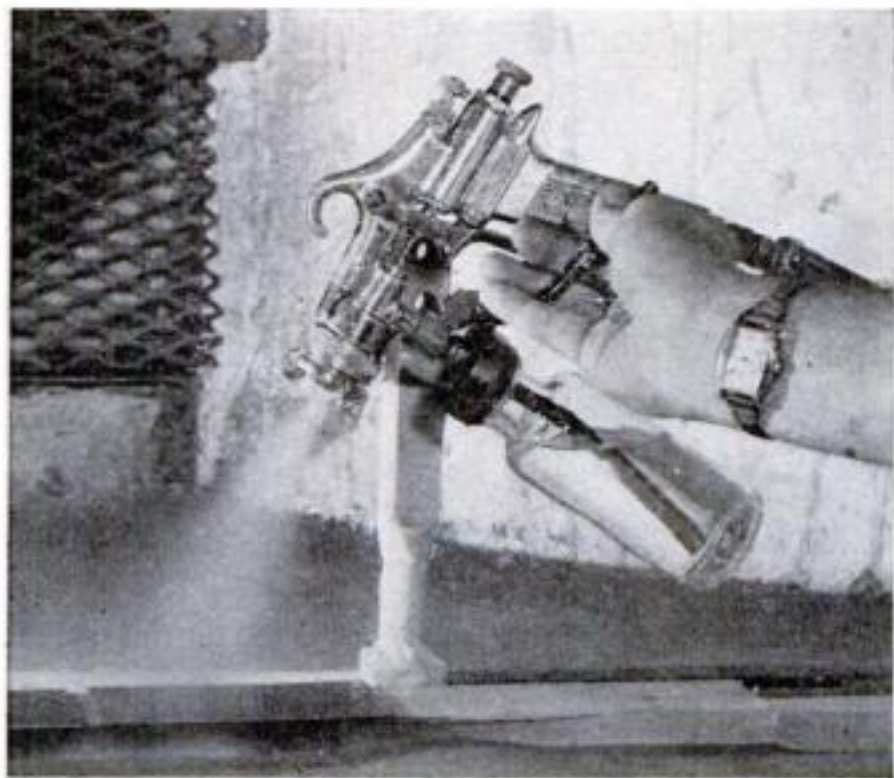
CHLORINE



PARLON

FLEXIBLE FILM
RESISTS ACID,
ALKALI, AND WATER
PREVENTS MOLD

Parlon-base lacquer is applied to a steel panel at the experimental laboratory with an automatic spray gun. This will assure a film of uniform thickness for the severe tests to which the paint will be subjected



Pigments being ground on a three-row mill. This and the machine shown on Page 59 duplicate in miniature the actual process followed in a paint factory. The technician here is mixing a chrome yellow, such as that on toys or brightly painted kitchen furniture

To determine the elongation and flexibility of the paint film, a panel sprayed as shown at upper left is given a conical mandrel test, in which it is bent around a steel cone. If the finish does not crack, even at the point of greatest strain, it is excellent

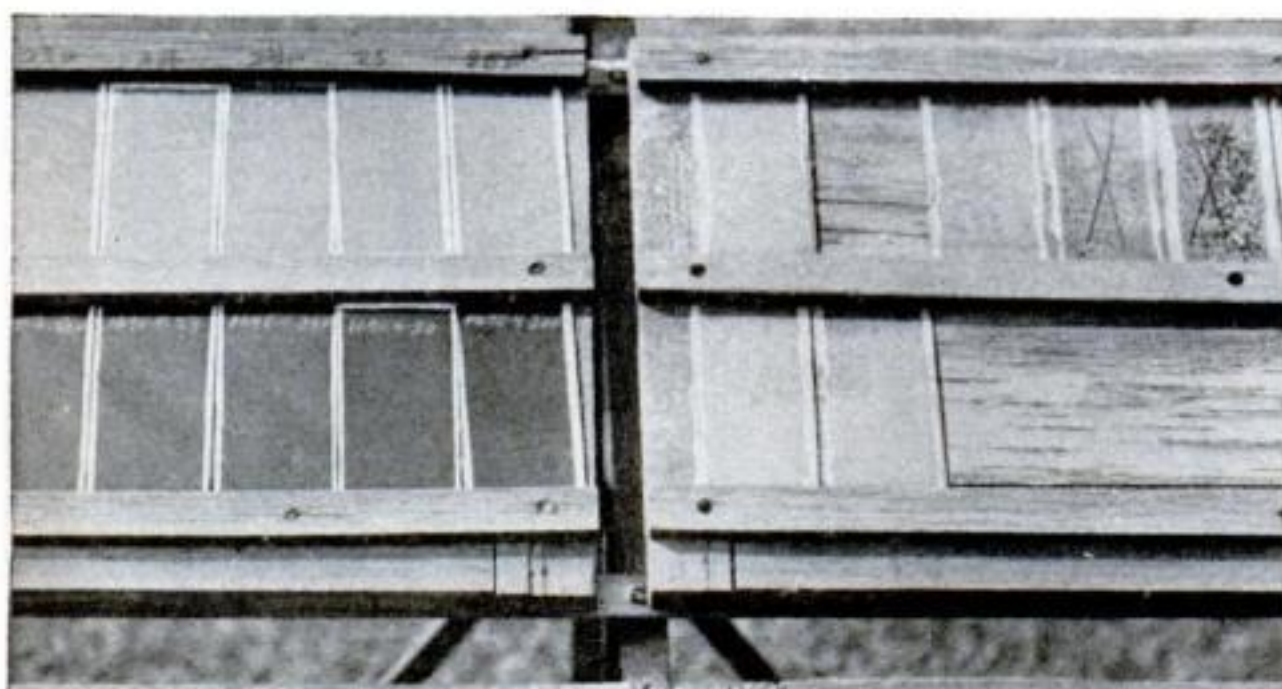
with oil paint and half with parlon paint, and then have been exposed to mold. The oil half becomes a jungle of spores, while the parlon side stays clean and blank.

Parlon resists alkaline action because it is chemically inert to alkalis. This has proved a boon in laundries and dairies. Alkaline soaps used in laundries are disastrous to many oil paints, but parlon paints have been left fresh and white after exposure. The makers have their eyes on filling stations, also, saying that the paints are impervious to oils, grease, and gasoline as well.

Parlon paint manufacturers are trying to get the paint adopted in mills and fac-

tories where resistance to corrosion is a needed factor. A large percentage of industrial plants comes under that heading. Parlon paints specially formulated have withstood in tests solutions of 50 percent ammonium nitrate, 5 to 50 percent sodium hydroxide, 5 to 70 percent sulphuric acid, 85 percent phosphoric acid, 10 percent hydrochloric acid, and 10 percent nitric acid; organic acids, such as 5 to 80 percent lactic; bleach solutions; corrosive gases, such as hydrogen sulphide, sulphur dioxide, ammonia, and chlorine itself; mineral oils; and salt water and fresh water.

Parlon paint seems to pull a rubber rain-



Above, concentrated nitric acid fumes eating into the finish on a panel. Rubber paint will stand up under this test for three weeks, it is claimed, while some others fail in two hours

Panels at left are facing the sun at an angle of 45 degrees in an outdoor test for weather resistance. In the photo, rubber-painted panels are shown at left, other finishes are at right

coat over many brick walls suffering from moisture seepage. One case was that of the Murray Hill Hospital on Manhattan Island near New York City's Grand Central Terminal. One side of the hospital was a brick wall twelve stories high. It was old, and for years had leaked water in every good rain. A coat of parlon paint stopped the leakage at once.

The city administration of New York has used it a lot, too. One leading example is the huge municipal swimming pool in Astoria, Queens. Fourteen thousand persons a day bathe there in summer, and in winter the paint gets a different type drubbing from the shoes of children playing organized

games on the drained bottom of the pool. Soot and gas from boats passing a few hundred feet away on the East River add another burden. Yet the paint has borne up.

Parlon colors are also urged by the sponsors for use on stadia, playgrounds, playground equipment, water works, fountains, auditoriums, prisons, and other public buildings, most of which now are monotonously sandy-hued.

The Hercules Company recommends parlon paint manufacturers to inquirers. So far it has expanded its parlon-base section twice, and will again when defense requirements are met and nickel is released for the necessary production apparatus.

AMERICAN NATIONAL BANK



Bank Gives Curb Service to Motorists with Novel "Teller-Vision" Cage

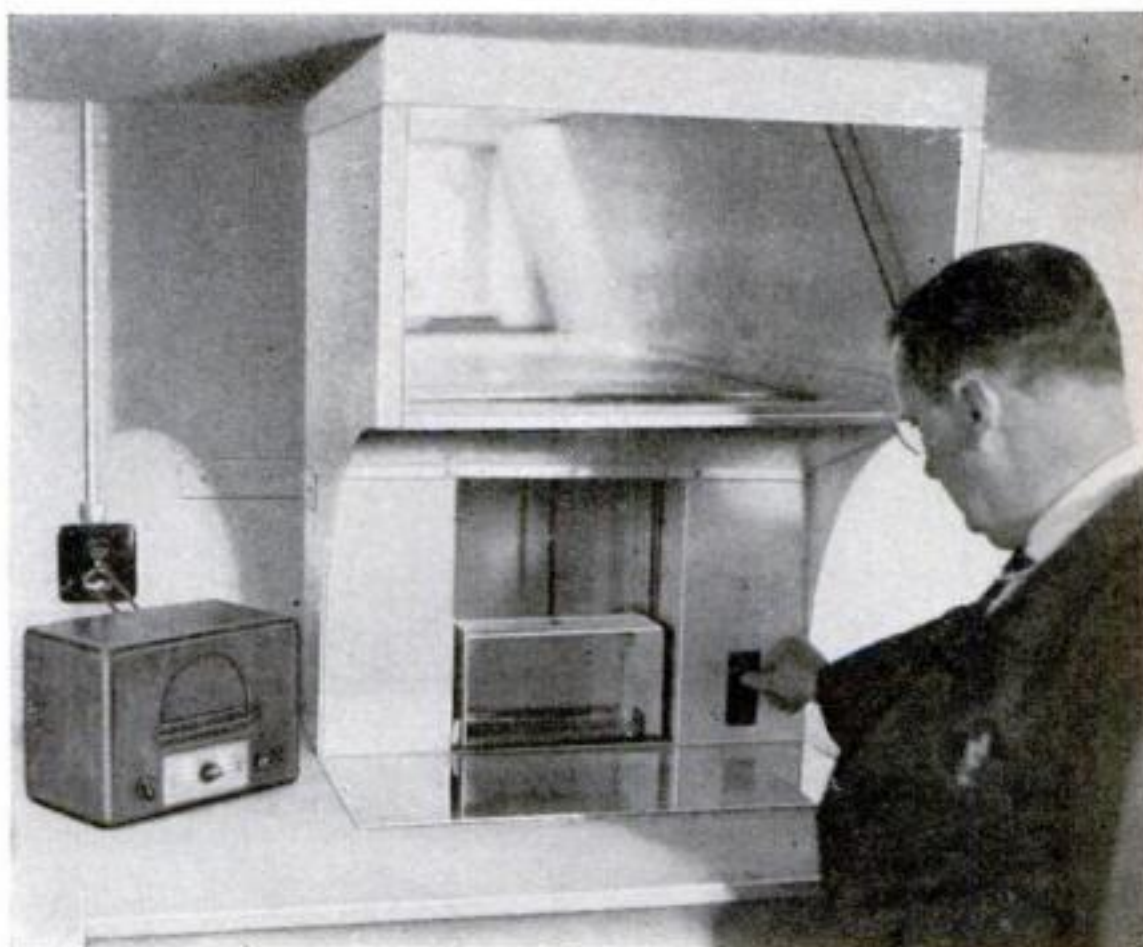
CALLED the first of its kind in the country, a curbside teller's window for motorists has been placed in service by the American National Bank, Portsmouth, Va. Without leaving his car, a customer may make deposits or transact other business. To forestall robbery, the teller occupies an underground chamber, but he and the customer see each other face to face through mirrors of a large periscope. An electrical system permits two-way conversation. Money and papers are conveyed between customer and teller by a miniature electric dumb-waiter, controlled by push buttons from below.



Customers in cars can transact their banking business at this curbside teller's window. It may also be used by pedestrians when the windows inside are congested

At upper right, a motorist makes a deposit. Through a shatterproof glass window he sees the teller face to face through a periscope arrangement of tilted mirrors

In his thugproof chamber underground, the teller operates the electric dumb-waiter and talks with the customer by means of a speaker system seen at the left





FLYING-SCHOOL PRANKS

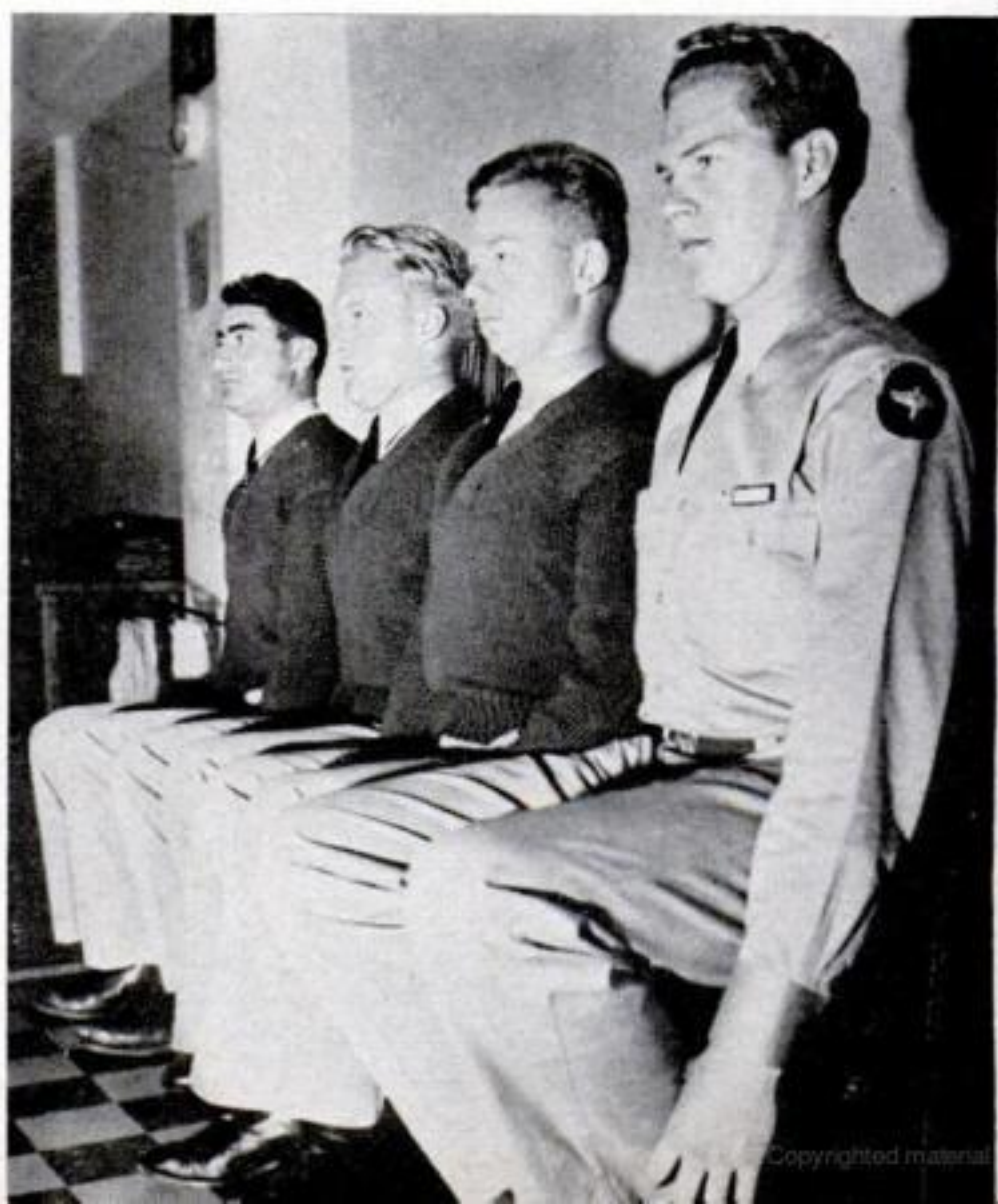
**Season Fledgling Pilots
at Randolph Field**

LEARNING to fly for the Army isn't all done in planes and classrooms at Randolph Field. The upper-classmen see to that. They keep the lower-classmen on the jump with various forms of fun that runs all the way from "bracing," or chest expansion, to "flying formations" while walking off demerits on the quadrangle. So that there won't be any cases of mistaken identity, lower classmen must wear their goggles around their necks when not flying, while their elders keep theirs on their foreheads.

A special lesson in "bracing" for a new cadet whose posture does not come up to Randolph Field standards. The chest is thrown out, chin and stomach drawn in

Waiting in the barber shop for the "Randolph Rip," as the official haircut of the field is called, a quartet of neophytes sits "at brace." The kidding of new men is mild and good-natured, as at college

Even in flying gear, it is easy to distinguish a lower from an upper-classman. The youngsters must wear their goggles down around their necks instead of in the conventional way on the forehead



From the minute they arrive at the field, cadets are reminded that they're "in the Army now." Here a group of new men, with their luggage in their hands, are being given a critical inspection by an old-timer. "Stand at attention—chins up, stomachs in," is the order from now on

Walking off demerits on the quadrangle, freshmen take orders from a gallery of upper-classmen. The men below are "correcting for wind drift"—turning in the toes and leaning as if to offset a side wind. The maneuver must be executed to meet the approval of all the onlookers

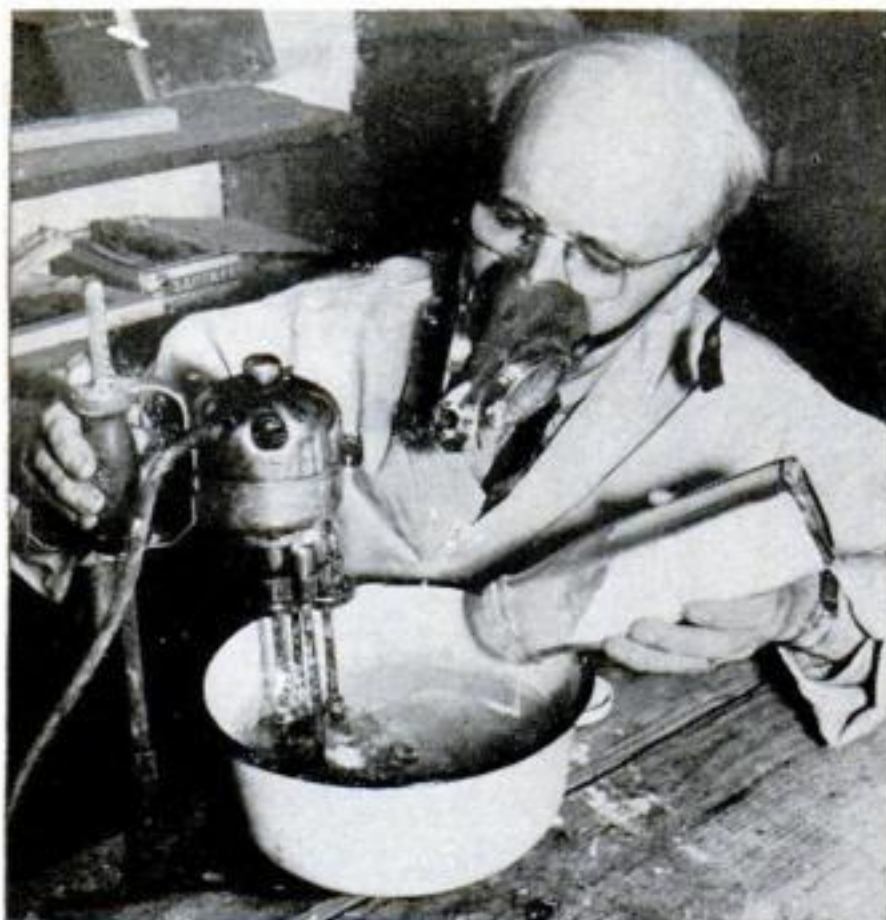


New men get "square meals" at Randolph. They must sit rigidly on the front four inches of their chairs, lift their food in angular movements like robots, keep silence



"Flying in formation" is another stunt that is required of men in walking off demerits incurred by doing anything wrong, such as neglecting to salute an officer or to say "Sir." Faulty work in the classroom can also bring demerits. These must be "walked off" by the cadets in their spare time on a pavement in the quadrangle. Upper-classmen are always on hand to see the fun and suggest stunts for victims

Chemical Fireproofers Smothers Fire Bombs



O. A. Hodnefield preparing a batch of his fireproofing compound with the aid of an ordinary kitchen mixer. He protects his lungs against the fine powder by wearing a nose mask. Sprayed over grass as shown in the photograph at upper right, the chemical is said to keep the grass fireproof for several months. Fire shields made of treated grass, like the one pictured at the right, have been developed for use by forest rangers in halting fires



NEW WAYS to fight the menace of incendiary bombs are proposed by O. A. Hodnefield, after 19 years of research in a small garage laboratory near Montrose, Calif. One of his schemes calls for spraying the fierce blaze with a fireproofing liquid of his invention, which he maintains will prove an effective extinguisher. Another method would smother the flames beneath fireproofed sawdust, previously treated with the same preparation.

Just what chemicals Hodnefield uses, and how he blends them, remain his secret. It takes only two men, however, to turn out 1,000 gallons an hour. At present he produces the fluid commercially for movie studios, where it fireproofs large drapes and cloth backings exposed to hot lamps. Aviation factories also use the material, he says, to safeguard walls, storerooms, and combustible parts of planes themselves.

Another wartime application of the composition, Hodnefield foresees, may safeguard stores or shiploads of petroleum. His tests

indicate that addition of a small amount of his liquid will keep crude oil from burning. When the oil is refined, it is separated from the fireproofing agent, which may be recovered for further use.

Originally, however, the inventor concentrated his attention on peacetime applications. A two-bedroom wooden dwelling, he estimates, could be rendered safe against fire at a cost of only \$200. He has also developed fire shields of treated grass, to combat grass fires. Except in a high wind, a row of these shields would halt the advancing flames.

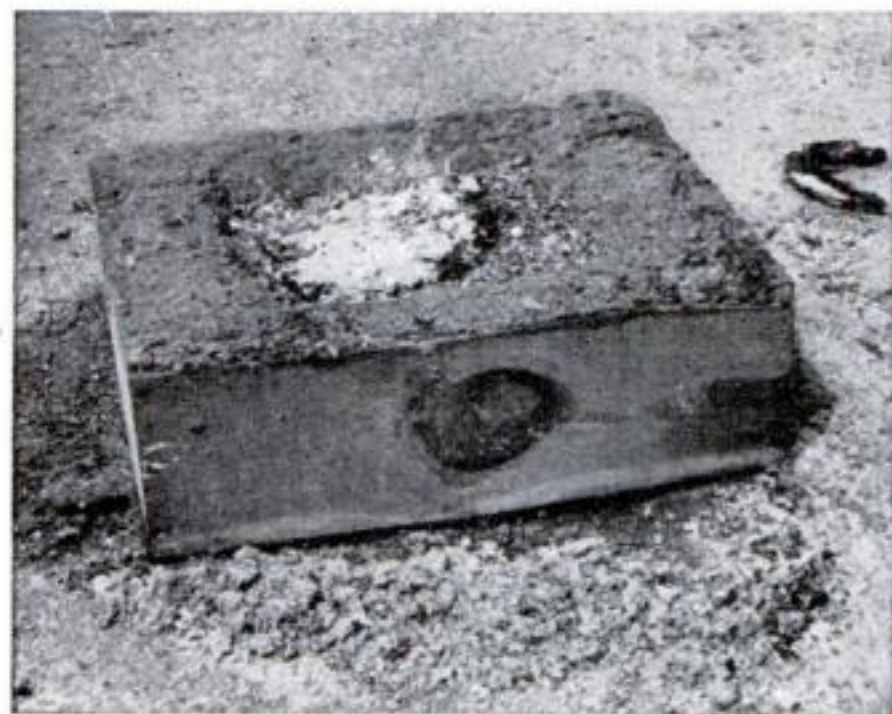
Photographs on these pages include views of striking tests applied to the fireproofing fluid. Other trials, according to the inventor, show that dry grass, treated 13 weeks earlier, cannot be set aflame with an oxyacetylene torch; and that the preparation successfully resists extraction from treated lumber by more than 1,000 washings with soap solution, or by steaming the wood and then subjecting it to a powerful vacuum.



To show the wartime possibilities of his invention, Hodnefield prepares a homemade incendiary bomb by pouring magnesium, aluminum shavings, and iron filings into a carton in a box of treated sawdust



... and places in its center a stick of phosphorus taken from the jar of oil in which it was kept to prevent its igniting spontaneously from contact with the air. Phosphorus is handled with pliers



Touched off with a burning newspaper, the "thermite" glows white-hot at a temperature of 1,600 degrees. In a regular incendiary bomb, the flames are started mechanically when it hits something

R. F. Scott, former Los Angeles fire chief and Hodnefield's associate in his bomb-fighting researches, sprays a film of the fireproofing compound on the blazing mass, and the flames quickly die down



This is all that happens when you put water on a thermite bomb. Smoke billows from the burning material and the flames leap higher. Other ordinary means of fire-fighting prove equally ineffectual

Another method is to cover the "bomb" with a few handfuls of sawdust treated with the compound, to blanket and kill the fire. Treated sawdust around the thermite is charred only a quarter inch deep





Tucked in bed in his sleep insurer, the daylight sleeper is prepared to get a full eight hours of rest with noises and light completely cut off

Sleep Booth

BUILT BY NIGHT WORKER IS SOUNDPROOF, AIR-CONDITIONED

TO INSURE himself unbroken rest for his eight-hour sleeping period, Joseph Landless, of Los Angeles, Calif., goes to bed in a portable light-proof, air-conditioned, sound-deadened compartment. It fits over a full-length three-quarter bed.

Landless got the idea for his "slumber insurer" several years ago when he went to work as night watchman for a wholesale grocer, and found daytime sleeping subjected to hundreds of annoying interruptions.

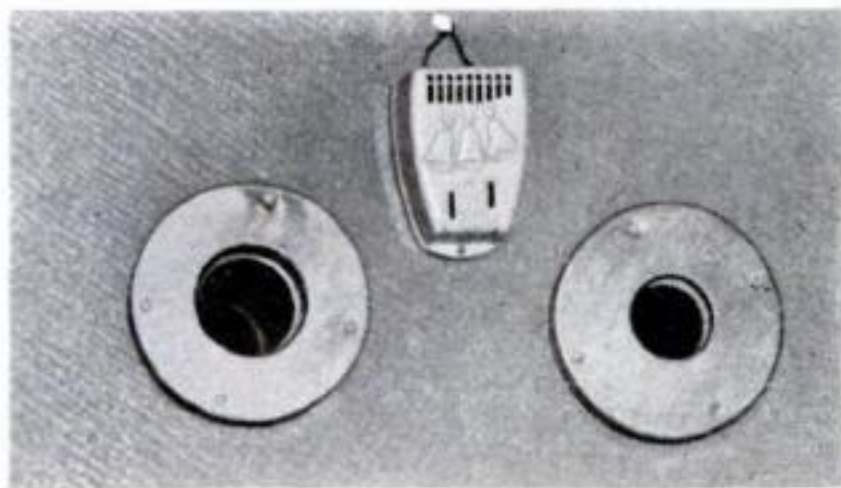
Picking up insulating materials, fans and other parts at second-hand dealers, he gradually evolved the compartment. It consists of a light framework and insulation materials. Walls and ceiling are three inches thick, and made of composition board and sound-proofing fiber. The cabinet is four feet wide, five feet high, and seven feet long.

On the hottest day, Landless sleeps in cool air filtered through a moistened excelsior pad set in a wall of his living room. Two fan blowers change the air twice every minute. Fresh air enters the compartment through a pair of circular inlets near the ceiling, and old air is expelled through two screen-covered vents in the ceiling at the opposite end.

When Landless slams the door closed, the compartment is completely dark. To guard against light leaks,



Door of compartment is three inches thick, as are the walls and ceiling. They are made of composition board and soundproofing materials. Sponge rubber seals the door against light



Two blower-type fans furnish a continuous supply of fresh air, drawing it through a moistened excelsior pad, above. In winter an electric heater takes the place of the cooling system. At left, above, old air is expelled through two screened vents in the ceiling

Air enters the sleep booth through the twin circular inlets shown at left. The buzzer between them does duty as an alarm clock, but isn't automatic; someone in the household must stay awake in order to buzz it

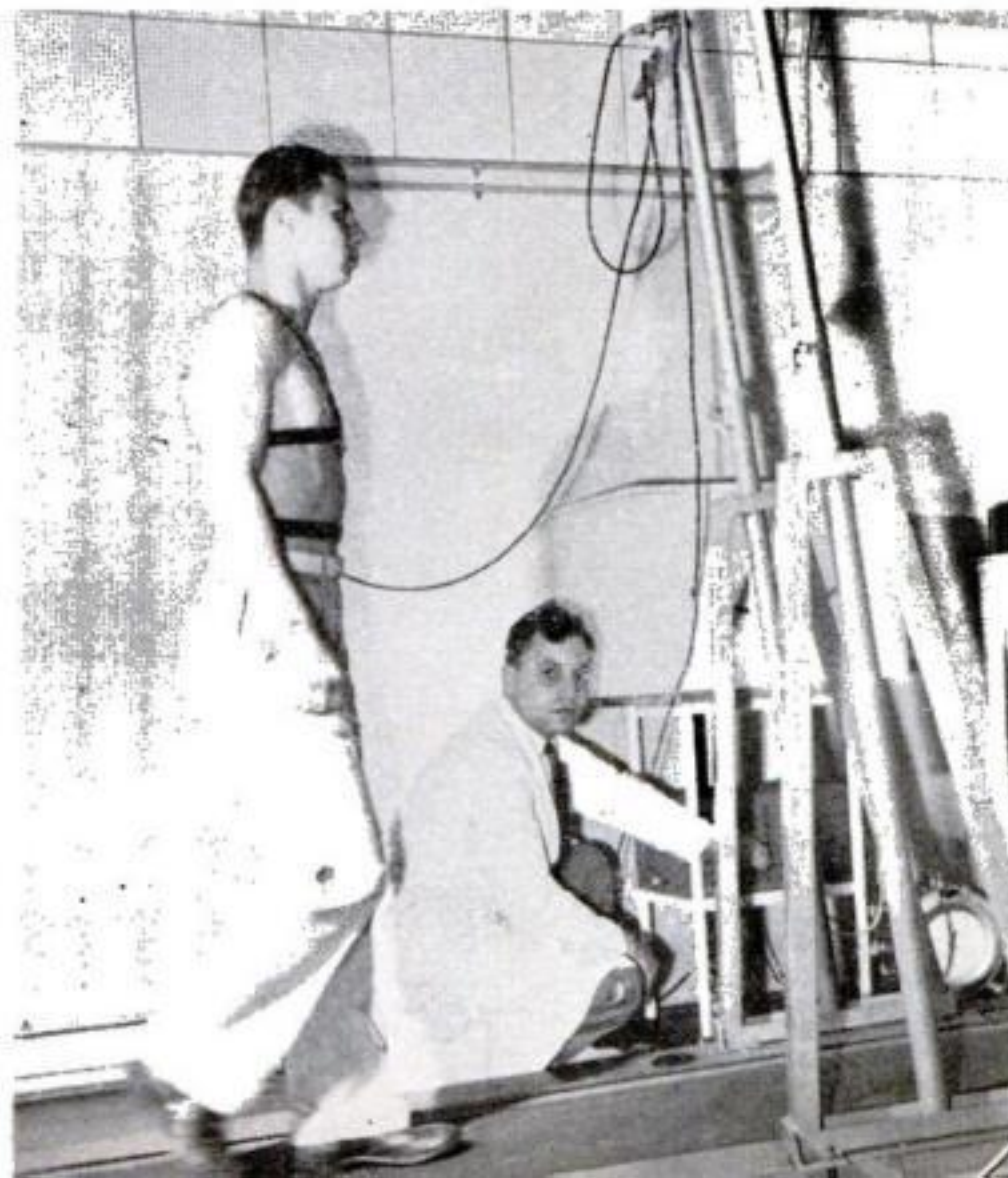
the door is sealed by sponge rubber strips, and the exhausted air zigzags around the edges of five baffles, which form an effective light trap.

In the winter, Landless changes the evaporative cooler for a small electric heating element. Not once in two years of daytime sleeping has he suffered a cold. Should he ever require treatment for a bronchial ailment, he plans to breathe the fumes of the

prescribed medicine as they waft across his bed through the air circuit, placing a few drops on the excelsior pad.

So effective has the system proved, Landless sleeps better in his tiny compartment during the day than in a near-by bedroom on his night off. In fact, he believes he has discovered an effective way for night workers all over the country to get their daytime sleep. The cost to him was only about \$60.

Soldier Guinea Pigs Help Science to Better Their Diet



PLAYING guinea pig while doctors make studies to determine the best diet for them is just another job for Uncle Sam's soldiers. At left, Private Wayne Stacy, of Waterloo, Iowa, walks a treadmill at the University of Minnesota after taking some of the high-concentrate vitamin capsules shown below, while a doctor checks his heart rate. The average soldier's diet gives him plenty of energy, but the capsules might be handy if supplies run low.



Carl E. Foss, New York color consultant, giving the new color-aptitude test using forty tinted grayish chips of metal. This test is said to provide a more accurate criterion of a subject's ability to distinguish colors than any method ever employed before

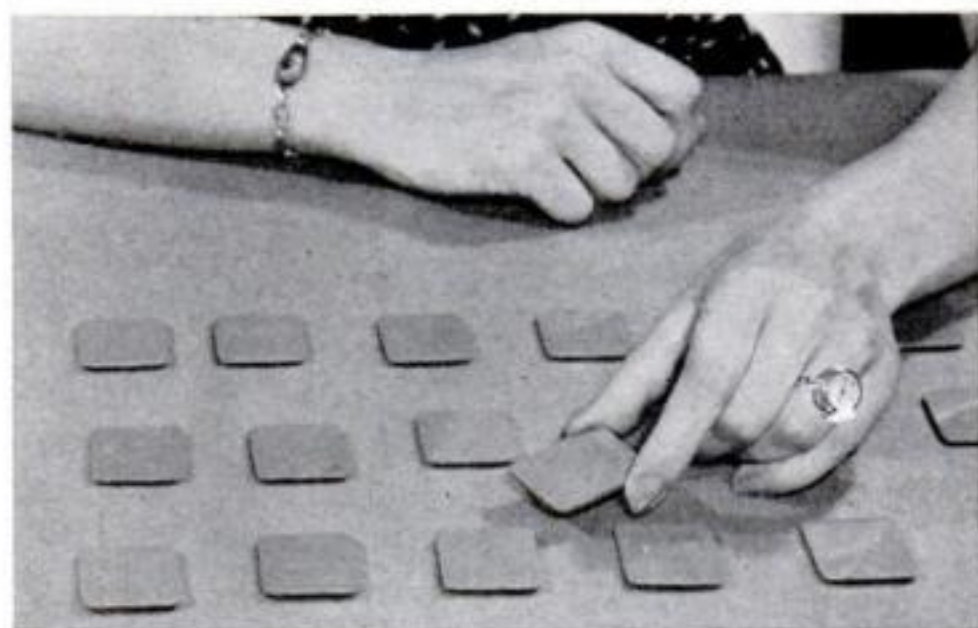


As the subject receives chips from a duplicate set, she matches them up with those laid out on the table before her

Matching Up Chips Provides Accurate Color-Vision Test

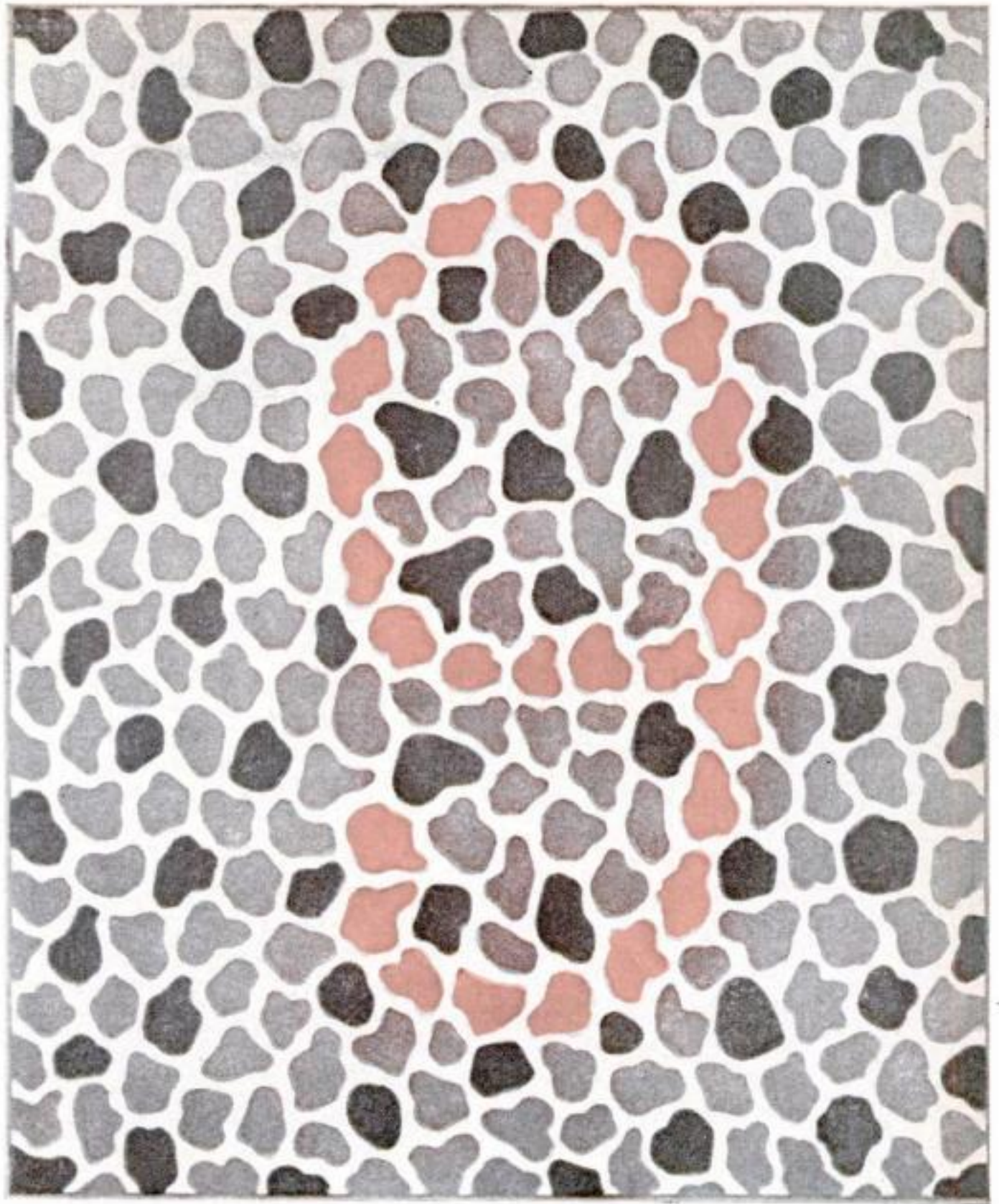
GRAYISH chips of tinted metal, spread out on a gray-topped table, provide a new and more delicate test for color vision. They not only detect major defects but are designed to give, for the first time, a scientific yardstick for measuring aptitude in distinguishing slight color differences. Such tests are expected to prove invaluable in selecting men with the greatest natural ability for matching textiles, dyes, and inks, and may be of help as well in picking the right people in various defense activities.

A committee of the Inter-Society Color Council, headed by Dr. Forrest L. Dimmick, of Hobart College, and Carl E. Foss, New York color consultant, developed the new test after months of research. The subject



is seated before a table on which forty chips, ranging in color from a weak red through gray to a weak red-purple, are laid out in even rows. Daylight, or the equivalent, illuminates the table. One by one, the subject tries to match chips from a duplicate pile. As each selection is made, the code mark on the back of each of the chips is noted on a score sheet. Later, conversion of the code from a key determines the number of right selections.

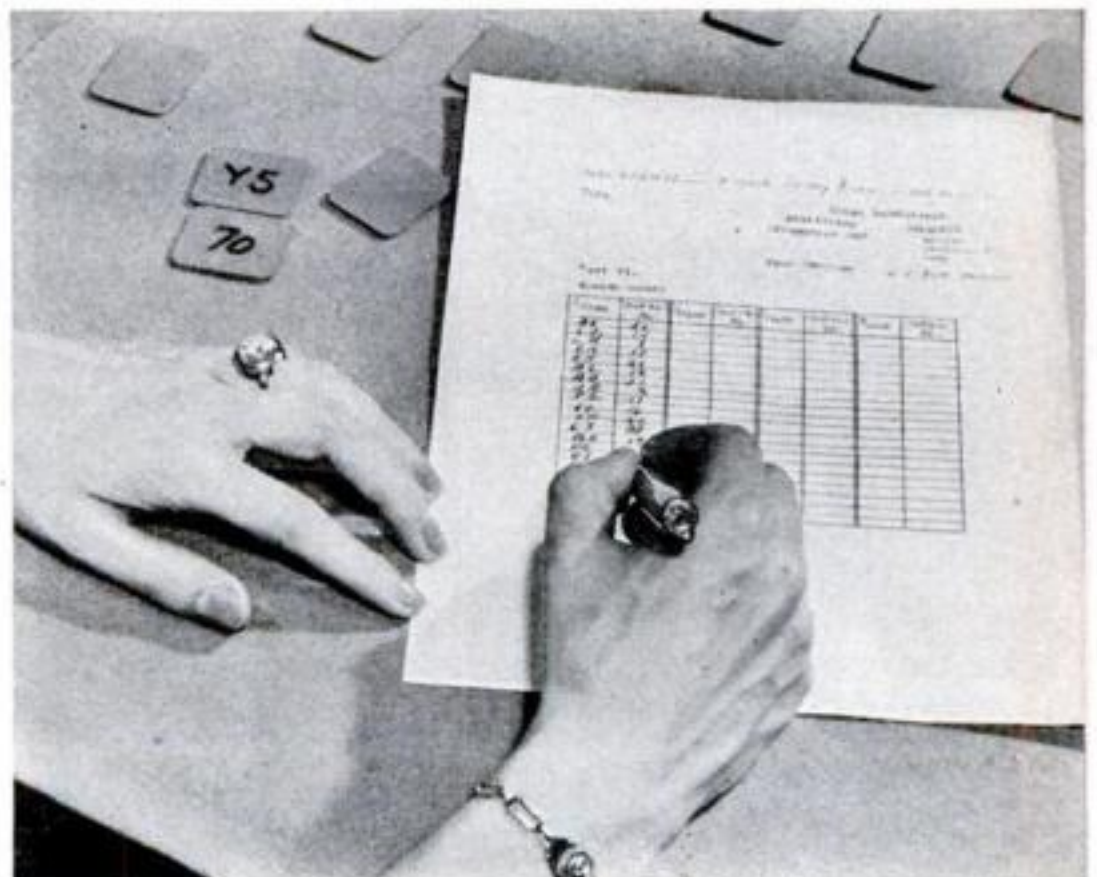
So slight are the variations in color that even experts fail to make a perfect score. For normal eyes, the test requires about three quarters of an hour. In two minutes, however, it will reveal any serious defect in color vision. Because the chips on the table are laid out in random order, and the matching ones are shuffled each time, there is no chance for the subject to memorize the test.

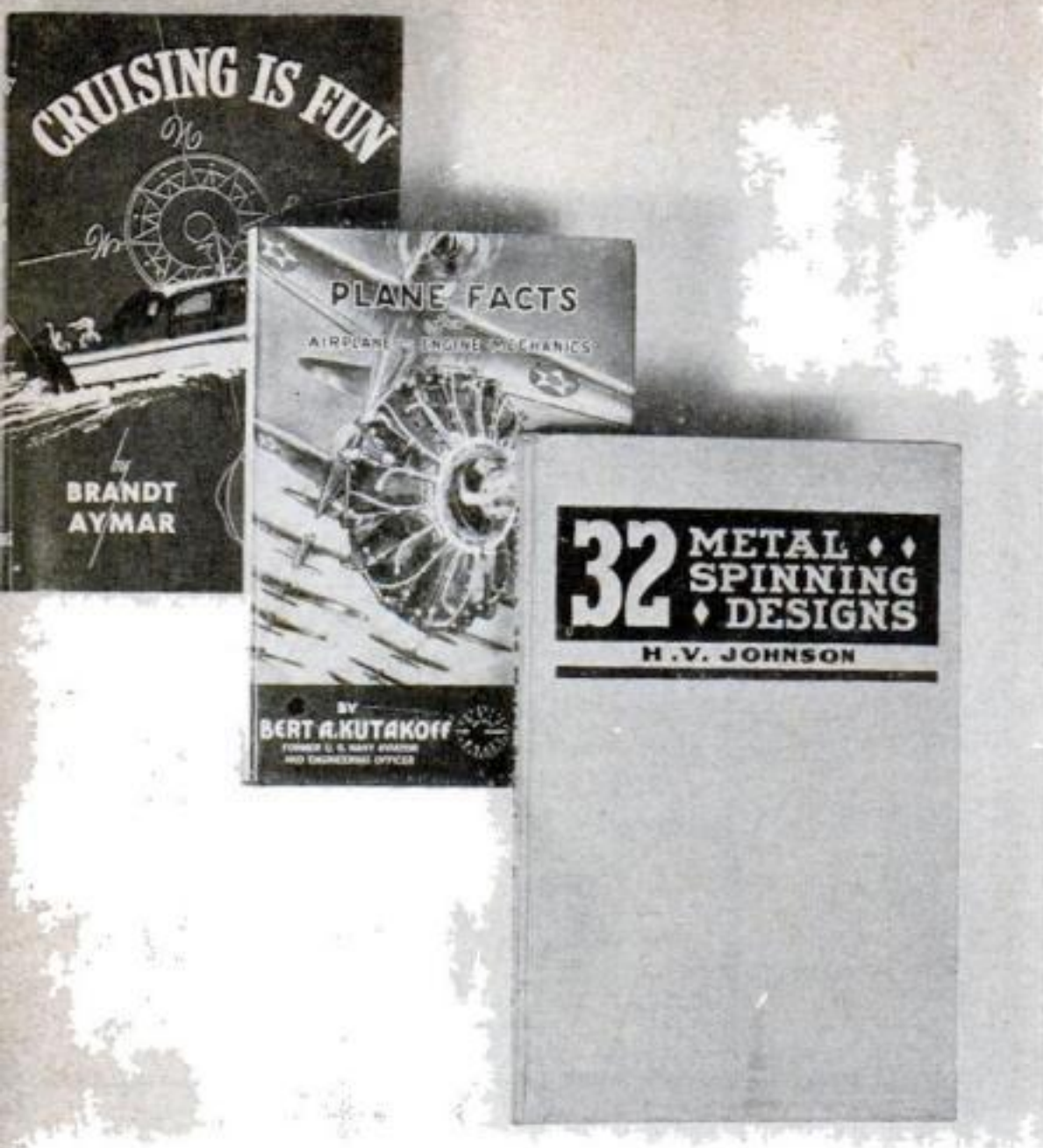


ARE YOU COLOR-BLIND? If you can't make out the number 9 outlined in red in the mosaic pattern above, you are color-blind to red. This is a standard test for detecting major defects in color vision



In the new test shown on the opposite page, a subject's score is found by noting the code marks on the table chips and on the duplicate pieces matched with them. Numbers are used on one set and letters on the other. Converting the code from a key shows the total of right and wrong selections made





GETTING IN ON AVIATION. In a short span of only 30 years or so, aviation has become one of our most important industries. "Plane Facts for Airplane and Engine Mechanics" (Military Book Company, \$1.75), points out the broadening opportunities for a job seeker in this field. In succeeding chapters the author, Bert A. Kutakoff, describes details of airplane maintenance and repair, with questions and answers showing their practical application.

HANDBOOK FOR YACHTSMEN. Simplified to basic essentials, for the benefit of average boat owners, "Cruising Is Fun" (Greenberg: Publisher, \$2.50) might be called a "how to" book for nautical enthusiasts. Its author, Brandt Aymar, gives an old salt's advice on planning a cruise; reading charts; plotting a course; allowing for winds, tides, and currents; navigating in a fog; calculating speed; and a goodly number of pointers on how *not* to handle a boat. Provisions of the new motorboat law of 1940, many of which have already been put in force, make up a useful section of the book.

METAL SPINNING is the art of raising disks of sheet metal into contoured forms by spinning on a lathe. In "32 Metal Spinning Designs" (Bruce Publishing Company, \$2), Harold V. Johnson describes the method, and offers amateur craftsmen detailed instructions for making a wide variety of beautiful and useful household accessories. These include ash trays, candlesticks, cigarette cases, flower-pot holders, and bowls and lamps of many kinds. To extend the choice of materials, the book contains several projects constructed from a combination of metal, plastics, and wood.

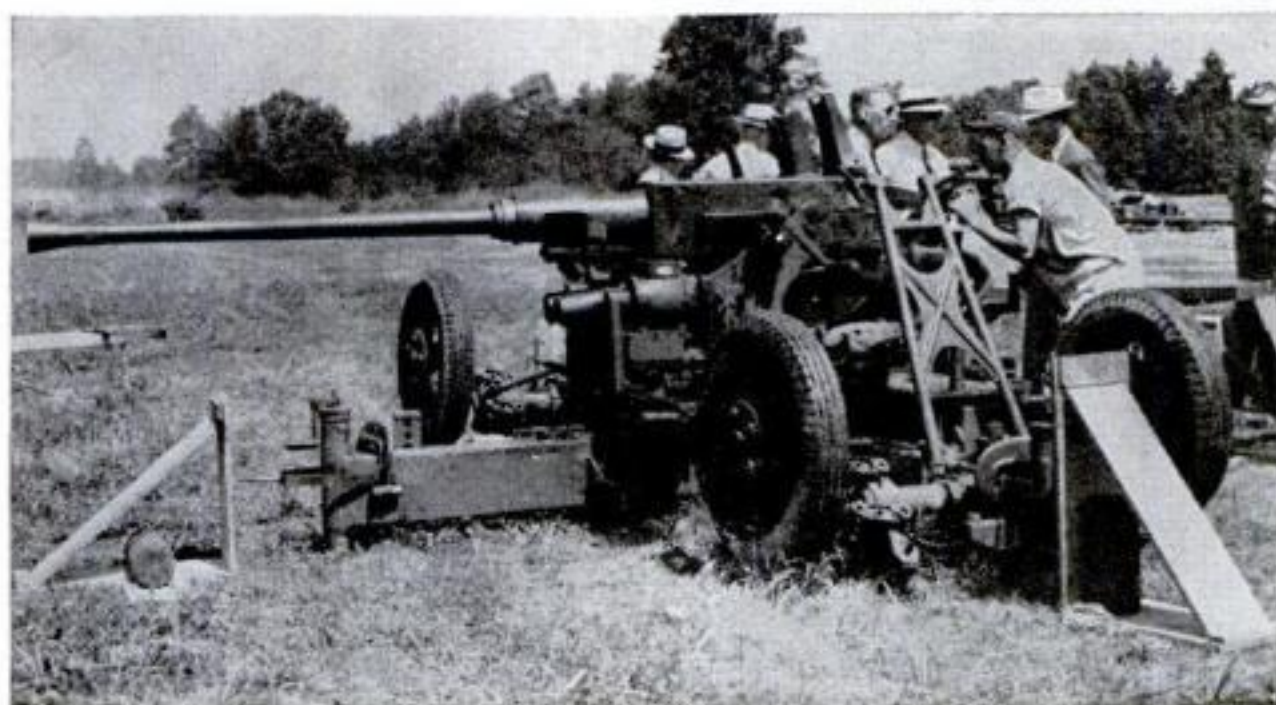
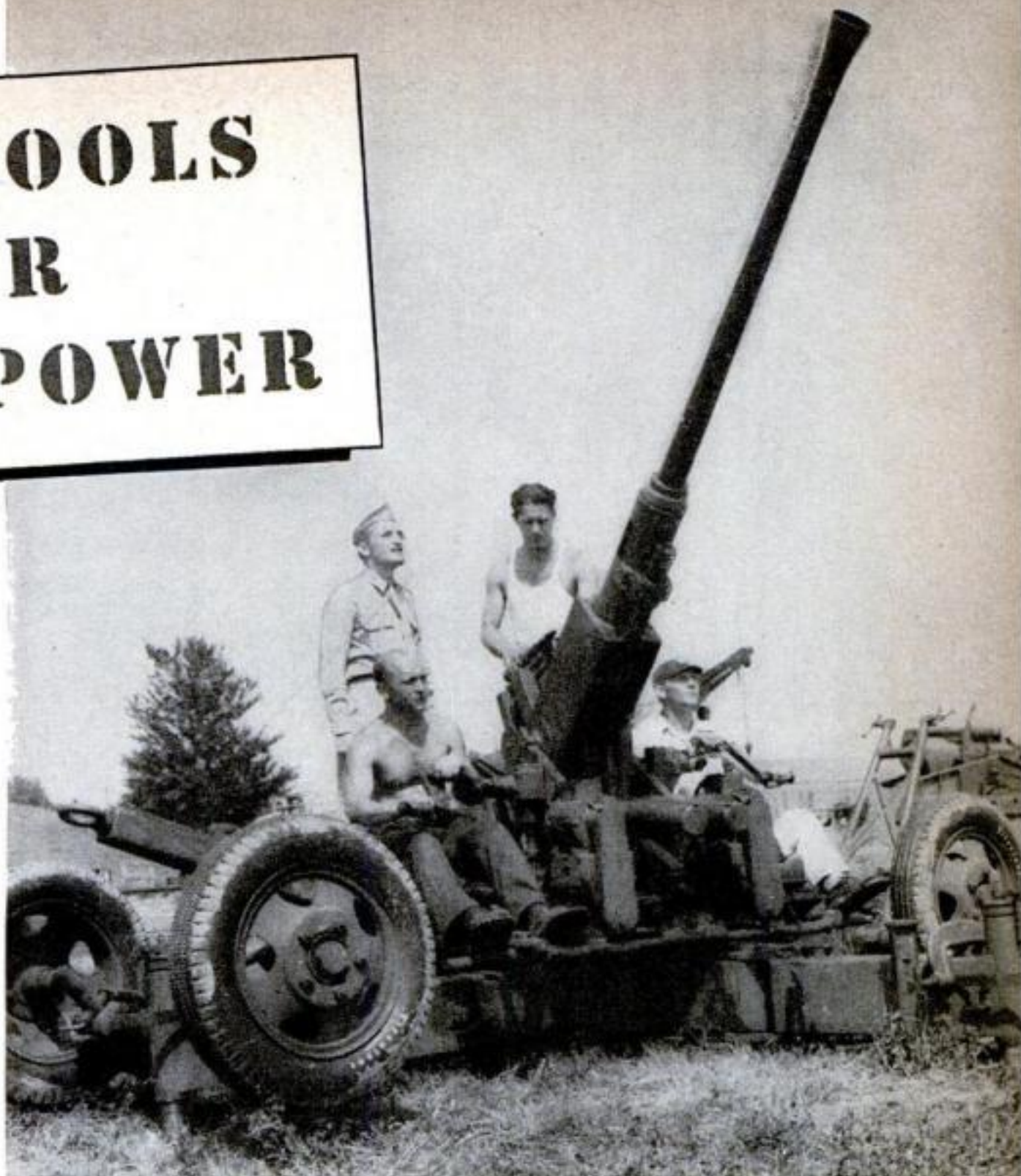
Question Bee

How much do you know about chemistry? Turn to page 222 to see how many of your answers are correct

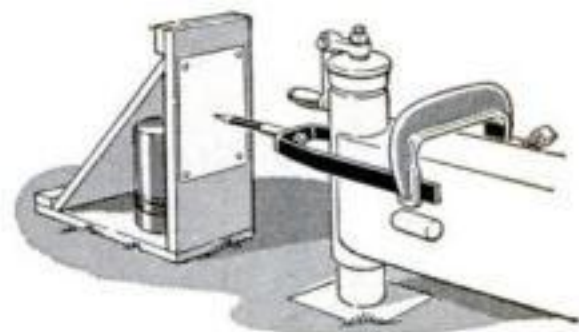
- 1 Dry ice is frozen (a) manganese dioxide (b) carbon dioxide (c) sulphur dioxide.
- 2 All of the following substances will burn, except (a) diamonds (b) iron (c) glass (d) ammonia gas.
- 3 Gasoline is (a) an element (b) a compound (c) a mixture of different compounds.
- 4 If a solid substance vaporizes without melting or decomposing, it is said to (a) effloresce (b) sublime (c) calcine (d) explode.
- 5 You would use an autoclave to (a) filter off a precipitate (b) weigh out minute quantities of chemicals (c) heat substances under pressure.
- 6 In the formula, $\text{Ca}_3 (\text{PO}_4)_2$, the part between the parentheses is called (a) a radical (b) an amalgam (c) a conglomerate.
- 7 Catalysts are used to (a) clean test tubes (b) promote chemical reactions (c) test precious metals.
- 8 An ester is (a) a specialist in pharmaceutical preparations (b) an organic chemical (c) a type of distilling apparatus.
- 9 Qualitative analysis will tell you (a) what a substance is made of (b) the exact amount of each constituent (c) the quality of the ingredients.
- 10 Any chemist should be able to (a) operate a woodworking lathe (b) cut and bend glass tubing (c) bake a cake.

NEW TOOLS FOR ARMY POWER

**American Genius
Matches Wit with
the Best Abroad
to Build Up a War
Machine Able to
Guard Our Shores**



NEW BOFORS 40-MM. GUN. It fires 120 two-pound shells a minute, at low-flying planes. At the left, it is undergoing the "jump test" that shows whether the recoil mechanism absorbs the "kick." Pencils on outriggers, as below, record any carriage movement



By ALDEN P. ARMAGNAC

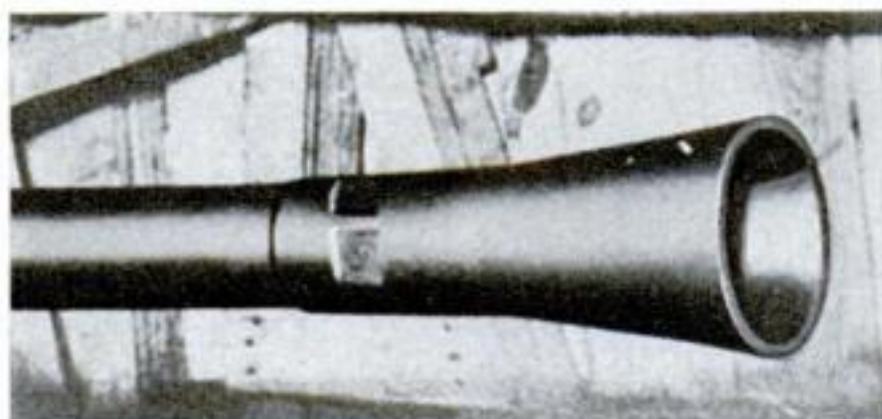
IN THE AIR, on land, and at sea, the U. S. Army is getting new tools to do its work. Eagerly studying the innovations of foreign warfare, military observers have brought home the fruit of its lessons. Inventive genius here has matched its skill against the best abroad. And weapons that existed only on paper, not long ago, now are being readied for any necessary "blitzkrieg" of our own.

One serious problem has been to find a suitable rapid-firing cannon for use against low-flying planes. Army experts believe they have found the answer in the Bofors 40-millimeter (1.6-inch) gun, a foreign design improved by such American refinements as welding instead of riveting. Trials of the U. S. version at the Aberdeen Proving Ground, Md., show that it hurls two-pound explosive shells at the terrific rate of 120 a minute.

Recoil mechanism of any gun should ab-



AMMUNITION FOR THE BOFORS is fed to the gun in clips, as shown in a factory test at left. The Chrysler Corporation will have this gun in mass production to the tune of 300 a month by late fall or early winter. Below is the business end of the Bofors, with its flared muzzle resembling that of a blunderbuss. This conceals the flash in firing. American experts have improved on the European design by refinements including welding instead of riveting



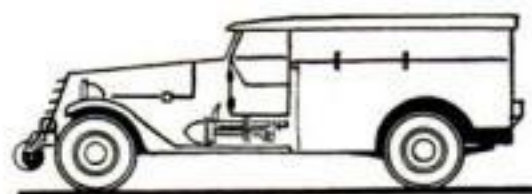
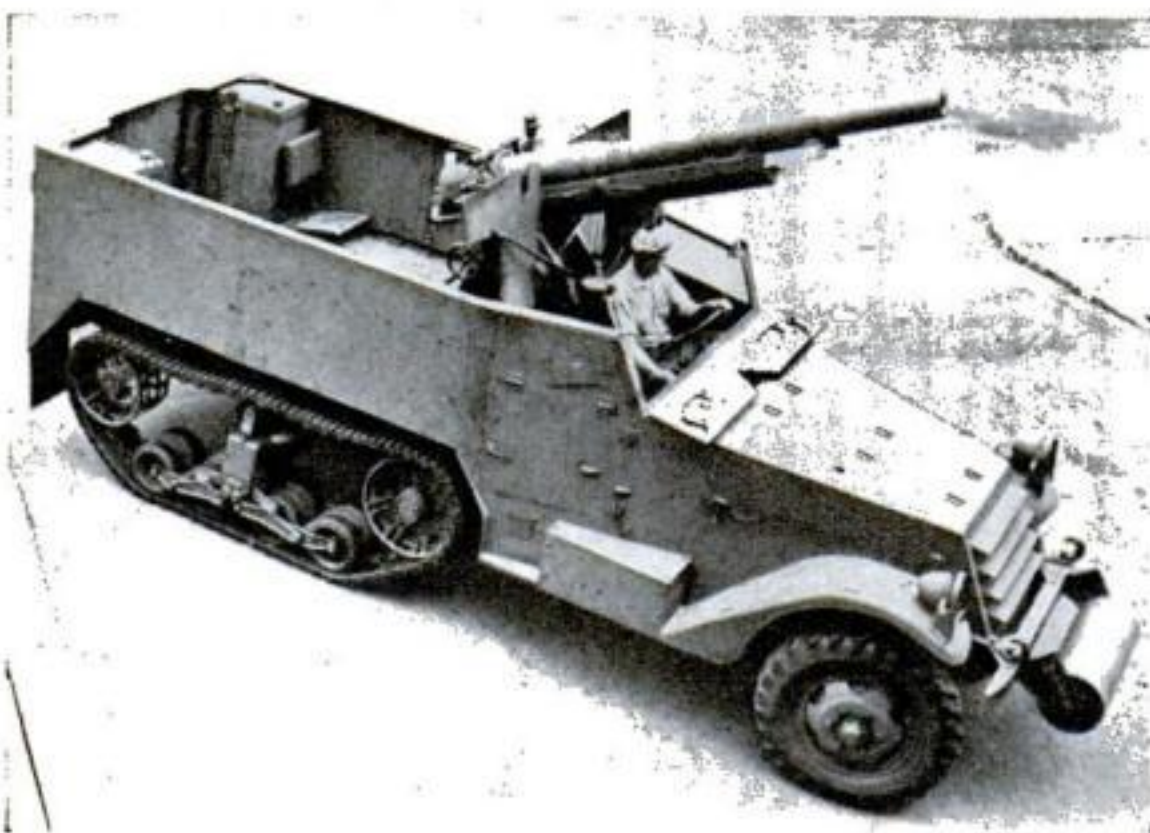
sorb the "kick" and return the weapon to firing position, without allowing the carriage to shift and spoil the aim. Hence the Bofors carriage had to pass a "jump test," as illustrated. Pencils mounted on outriggers are pressed by springs against cardboard thumbtacked to fixed wooden stand-

ards. When the gun is fired, any movement of the carriage will automatically be traced by the pencils on the cardboard.

For computing range and elevation of ground targets, airplane maps now are supplemented by a remarkable instrument called the Wild T2 theodolite. This device

operates on the general principle of a surveyor's transit, but with such extraordinary precision that it locates targets at great distances within the bursting area of a six-inch shell. Its scale reads to one second of an arc, or to a 1/3,600 part of a circle. Gas masks for theodolite users have special eyepieces.

If need be, the U. S. Army will be prepared to fight fire with fire. Flame throwers



NEW VEHICLES. From the seven-man scout car (top drawing) Army men now have evolved the armored 14-man personnel carrier in the upper photo. And, just as the eight-man car-personnel (bottom drawing) proved useful as a mount for a mortar, so the personnel carrier mounts a "75" and becomes our first self-propelled gun platform



OPTICAL ADVANCES. For laying the base lines for aerial mapping, the Wild T2 theodolite gives such accurate readings that it makes possible the locating of targets at great distances within the bursting area of a six-inch shell. Tank crews get new safety from a periscope resembling the Canadian model shown above, which permits the use of a shield to stop bullets

used in Europe, for assault on concrete fortifications and for infantry defense against tanks, look bulky and cumbersome beside a compact 70-pound model recently demonstrated at Fort Belvoir, Va. Carried like a pack, its tank projects a 2,200-degree flame to a range of 90 feet. Bursts of as long as 18 seconds are fired by a trigger on the nozzle. In contrast with other types, its carrier need not wear asbestos clothing.

A 50-ton juggernaut, first of a new series of heavy Army tanks, was nearing completion at this writing. Its reported innovations will include a "tank periscope," already tried out successfully in Canada, through which the commanding officer will direct the driver and aim gun-fire. A block of armor

behind the observation slit stops machine-gun bullets that might enter and ricochet within the tank.

To rush troops into battle, the Army has perfected a new armored personnel carrier, whose lengthened body provides room for 14 soldiers—twice the number that could be transported in former "half-track" models. Another version of the latest design constitutes the first self-propelled mount for a field gun of 75 millimeters (three inches). Like earlier half-tracks, the hy-

FLAME THROWERS tested recently at Fort Belvoir, Va., are more compact than European models. Controlled by a trigger on the nozzle, this weapon throws a 2,200-degree flame for 90 feet in bursts as long as 18 seconds





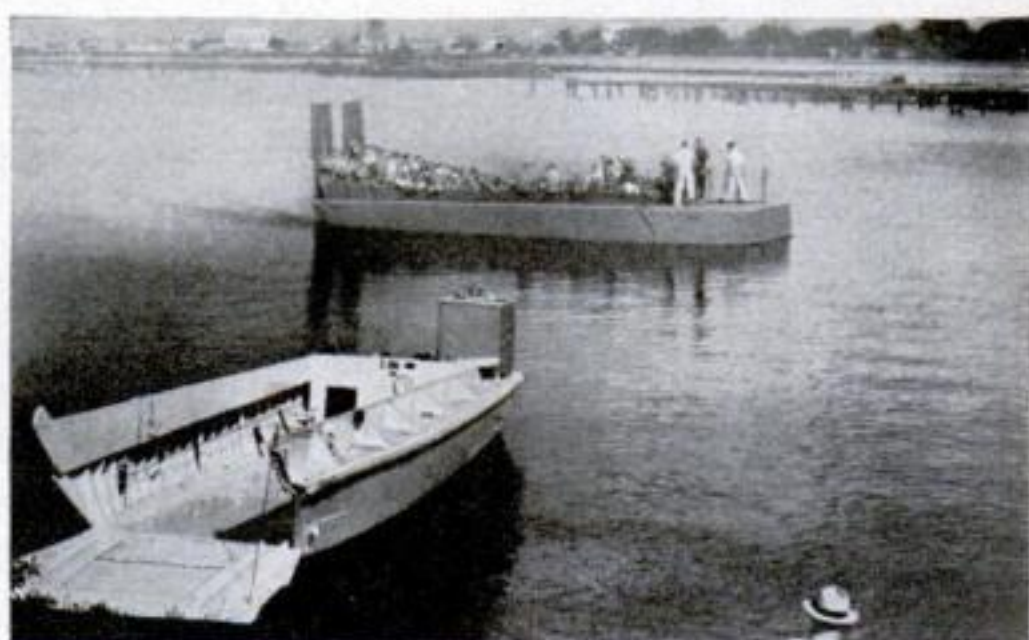
LANDING TROOPS on hostile shores is practiced in joint Army and Navy maneuvers off the Florida coast. At the left, infantrymen are piling into a landing boat from a transport. Above, a squad car goes over the side for the trip ashore. Below, one of the larger landing boats is carrying a 15-ton tank



brid vehicles travel on tractor treads at rear, and wheels in front, plus a cylindrical roller that enables them to wallow through mud, slush, and sand.

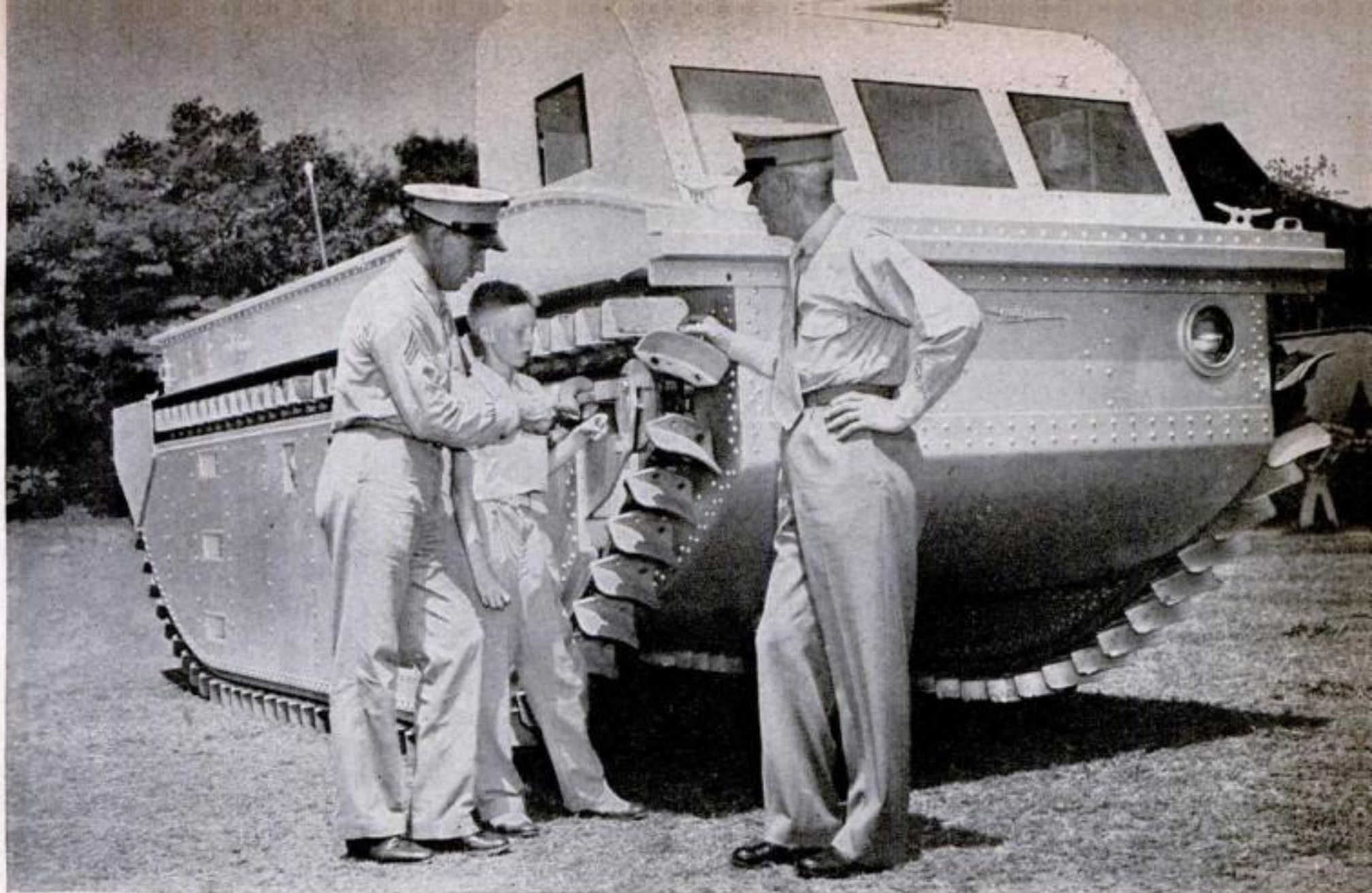
Joint Army and Navy maneuvers anticipate possible troop landings upon enemy-held shores. Latest types of landing boats vary in length from 36 to 45 feet. The

smaller model carries 39 fully armed troops, or an armored scout car. Mounting a machine-gun turret in its bow, it speeds at 25 knots under the power of its 250-horsepower Hall-Scott motor, and can lay a smoke screen to conceal other landing boats. Loaded from a transport, it is driven right up on a beach. If reversing the boat fails to



In a test at the plant of Higgins Industries, Inc., manufacturers, 188 workmen are crowded aboard one of the 45-foot landing boats. In the foreground is a 36-foot boat designed to carry light vehicles

At the left, a fleet of landing boats maneuvers in another factory test. In the lead is a 70-foot motor torpedo boat acting as a mother ship. The landing boats have machine-gun turrets in their bows, and are driven by 250-horsepower engines at 25 knots



float it again, a kedge anchor thrown sternward is drawn in by a winch to free it.

The larger, 45-foot boat ferries 188 men ashore at a time. Alternately, it can carry a light 15-ton tank or a husky tractor. Diesel motors power these twin-screw craft. Photographs on these pages, some published here for the first time, illustrate typical maneuvers.

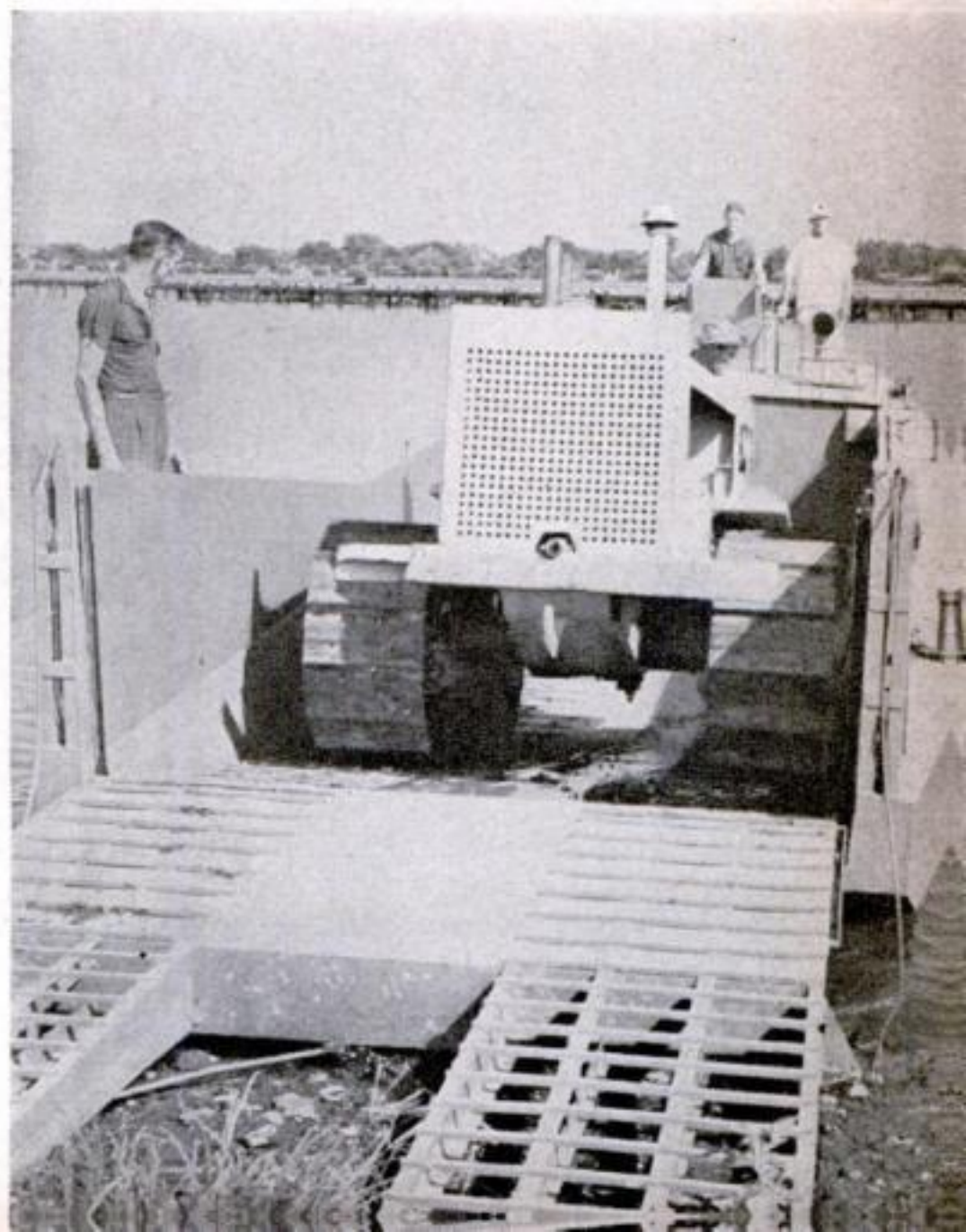
AN AMPHIBIAN, like the Marines who use it, this queer land-and-water craft can be unloaded over the side of a ship to make its way to land at nine miles an hour. On shore, it carries 20 fully equipped Marines at 28 miles an hour. Armament consists of two machine guns. The Marines are specialists in landings



Workmen disembarking from the large landing boat after the trial shown on the opposite page. As seen here, it can be driven right up onto a beach to discharge its cargo of men or vehicles

A tractor crawls ashore over the lightweight landing stage of open construction which comes down from the end of the boat. This particular boat was designed for the transportation of 15-ton tanks to the shore to cover landing parties

OCTOBER, 1941



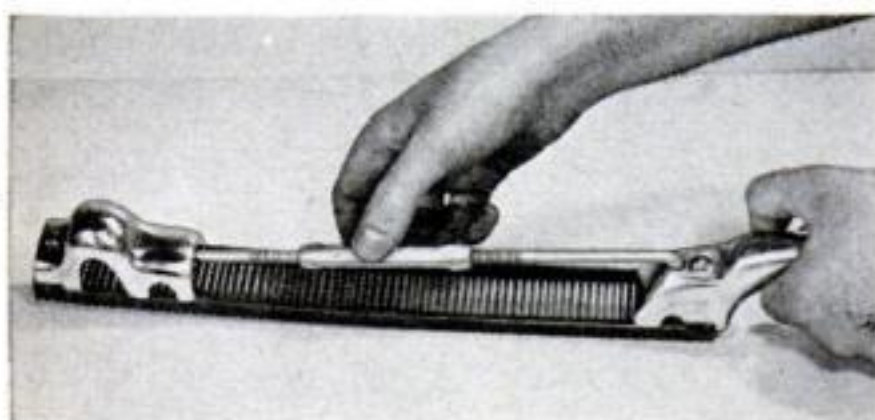
Joseph Anton Shredl with his guitars—all he has kept from the 200 made in the last 50 years. The wood in the darker ones came from a black-walnut newel post taken from an old Virginia home



Cabinetmaker Builds Guitars as Hobby for a Half Century

MAKING guitars of exquisite beauty and tone quality provides a spare-time hobby for Joseph Anton Shredl, cabinetmaker, of Floral Park, N. Y. Their delicate inlay work reflects his skill at his regular craft. But most of all he prides himself upon their bell-like tone and exceptional resonance, secrets it took him 50 years to find.

In that time, he has constructed more than 200 guitars—and taken nearly all of them apart again. He retains about a dozen, the finest that his efforts have produced, which hang on a wall in his parlor. Several were made of black walnut over 200 years old, taken from a newel post found in a Colonial mansion in Richmond, Va. Would he sell one of them? He doesn't know—but, if he did, it would be to a musician who could appreciate the high quality he has built into the instrument.



File Has Slots to Pass Chips

SLOTS between multiple blades allow chips to pass through the file pictured above, without clogging it. The advantage becomes marked in filing nonferrous metals, plastics, and hardwood. A detachable knob-and-turn-buckle assembly changes the shape of the tool from flat to slightly convex or concave.



Dry Cell Stays Fresh

A **FLASHLIGHT** cell of new design defies deterioration while it stands on a dealer's shelf. Its carbon rod, electrolyte, and zinc casing remain out of contact until an inner glass bulb is broken by a sharp tap. This allows the electrolyte to escape into the filler compound, energizing the cell to full strength in less than a second. In other respects, it resembles any other cell.



Dry-State Cell



Conventional Cell

Seated in this chair of special design, an actress can relax as she is freshened up for another scene. To have a shampoo, she is wheeled over to a wash basin and the chair is tilted backward as is shown at lower right



Stars Use Make-up Chair

MOVIE actresses rest comfortably, while receiving make-up or hair washes, in a novel "shampoo chair" with tilting back and seat, the latter of extra length. Casters enable the chair and its occupant to be wheeled easily between make-up mirror and wash basin. More practical than luxurious, the device helps prevent fatigue on a busy day, when an actress may have to visit the make-up department repeatedly to keep fresh for successive scenes.



Sun-Lamp Bulb for Homes Has Built-In Reflector

FITTING any household screw-type socket, a compact new health lamp emits artificial sunlight, including both ultra-violet and heat rays. The unit has a built-in reflector and a screen of special glass to remove unwanted rays. According to General Electric designers of the lamp, this eliminates any need for wearing goggles.

The "indoor sun bulb" consumes 275 watts of electricity, and operates on standard household alternating current of 110 to 125 volts. A hermetically sealed glass shell excludes dust and moisture to preserve the efficiency of the mirrorlike reflector. The bulb contains both a tungsten filament and a quartz mercury-arc tube. To conserve aluminum for national defense, the reflector contains only a negligible trace of the metal.



Cut-away view of the proposed surgery trailer. Patients would enter the gasproof steel shell through the door at far right

TWO-WAY
SHORT-WAVE
RADIO

GASPROOF DOOR
HERMETICALLY
SEALED

WATER
TANK
FUEL

GASOLINE-MOTOR
GENERATOR

HYDRAULIC
STABILIZER
JACK

- | | |
|-----------------------------|-------------------------|
| 1. Basin | 6. Anesthesia apparatus |
| 2. Operating table | 7. "Incoming" bed |
| 3. Solution stand | 8. Runway |
| 4. Autoclave and sterilizer | 9. "Outgoing" bed |
| 5. Major light | 10. Lockers |

Operating Room Goes to Battle in Tank-Towed Armored Trailer

TOWED into battle by a war tank, an armored operating room for front-line casualties has been designed by C. J. Birtcher, a Los Angeles, Calif., manufacturer of surgical instruments. Emplacements cut in a hillside by bulldozers would hide such trailers from enemy view. Each one measures 35 feet long, is gasproof, contains complete surgical equipment, and has steel

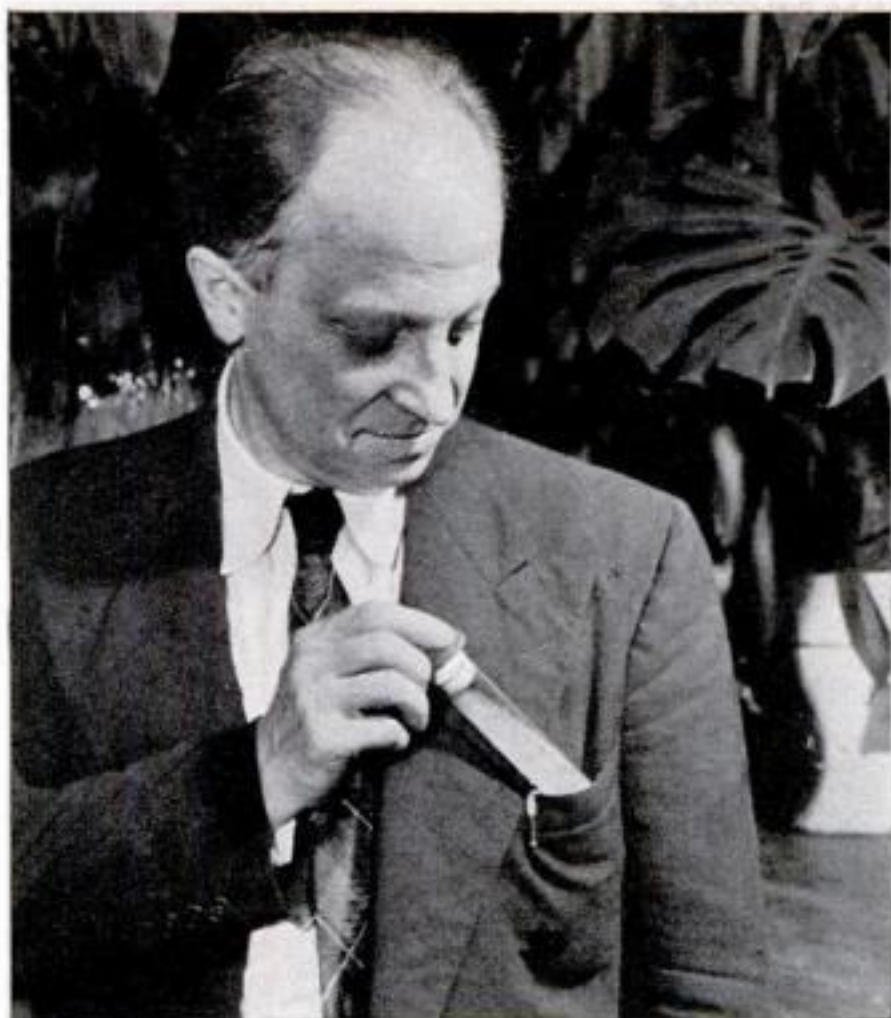
walls capable of withstanding machine-gun bullets and shell fragments. Within, a two-man surgical team could handle as many as 30 cases an hour, safe against anything but a direct hit by bomb or shell. Similarly armored vehicles, of 16-man capacity, would bring in the casualties. As each arrives, he is placed on an "incoming" bed, anesthetized, and transferred to a hydraulic operating table. Following surgery, he is transferred to an "outgoing" bed to await transportation to a hospital in the rear by armored ambulances.

White Plastic Paint for Dials Keeps Instrument Faces Clean

INSTRUMENT dials with a new white plastic finish resist discoloration that would make them difficult to read in an emergency. Used in military tanks, aircraft, ships, and on industrial machinery, the dials are the result of five years of development under D. A. Young, Westinghouse engineer. An automatic spraying process first applies the plastic coating to metal dials. Markings then are added, in special printing inks, with accuracy of less than 1/5,000 of an inch from perfection. Finally, as at left, a workman with a magnifying lens punches tiny holes in the dials to align them on a machine that will cut them apart. Samples have been exposed to tropical and polar weather, biting salt vapors, and oil and tar smoke without harm.

POPULAR SCIENCE



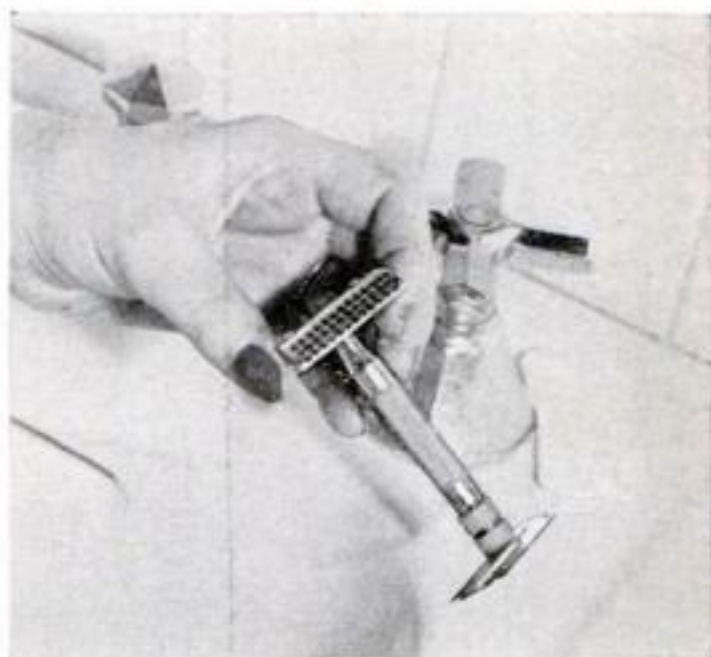


Garden in Test Tube Starts Orchids Growing from Seed

A POCKET-SIZE garden enables Dr. Justin Zender, New York City biochemist, to give orchids their start in life. It consists of a tightly stoppered test tube containing agar-agar and several chemicals, in which he has planted from 50 to 100 of the almost microscopic seeds. These germinate in a month or two, but the plants remain in the test tube for six to 18 months. Then, transplanted with a platinum wire, they grow for two years in glass flasks, and finally in pots. It takes seven years, on the average, from seed to bloom. Dr. Zender employs a nutrient agar-agar solution worked out by Dr. L. Knudson, of Cornell University, pioneer in growing orchids successfully from seed by using a sterile medium. The test tube at left will yield reddish-violet orchids of a South American variety.

Magnet in Safety-Razor Handle Picks Up Blade from Basin

HANDLING a razor blade without nicking a finger becomes simple, with the introduction here of a safety razor manufactured in Sheffield, England. The base of the handle contains a tiny permanent magnet, only a fourth of an inch in diameter, but powerful enough to pick up a blade from the smooth surface of a wash basin, as at right. It represents one of the newest applications of recently developed alloys which have greater magnetic attraction than steel alone. The razor may be adjusted for either close or easy-going shaves.



Infrared Drying Lamp Bakes Paint on Autos

WHEN synthetic enamel is applied to a car, a new infrared or radiant heat lamp makes a speedy job of drying the finish. Wrinkling, sagging, and prolonged tackiness are halted by the penetrating rays, which, according to the maker of the appliance, bake the paint film from the inside out. Tungsten-filament bulbs used have sealed-beam mountings similar to those of automobile headlamps. Six are grouped within a hood, attached by an adjustable arm to a stand with casters, so that the rays may be directed upon any part of a car. The life of the bulbs is estimated at from 5,000 to 10,000 hours.





How

SOMEONE years ago said, "War is for the general, an art; for the officer, a science; for the soldier, a trade."

No war agency demonstrates this more clearly than that greatest of modern weapons, air power. The fist of the air arm is the bomber, and the long-reaching arm defies fortifications, unfavorable terrain, and great expanses of sea when the time comes for the deadly punch to be delivered. In order to thwart aerial and ground opposition once these far-removed objectives are attained, the bombers fly by night more frequently than during the daylight hours, particularly when their missions involve the bombardment of stationary, well-defended sites such as cities, industrial areas, and wharfage.

Indeed, where the balance of air superiority is closely contested, where the air arms boast parity of quality, quantity, and flying personnel, day bombing of such objectives has proved too costly; except, perhaps, for sporadic, hit-and-run raids by fast fighter-bombers and dive bombers. Precision bombing of targets is abandoned in favor of widespread incendiary and demolition bombing on an indiscriminate scale calculated to destroy the morale of civilians in a "war of nerves."

Some rather interesting tactics are employed by the night bombers. Moonlight visitations are frequent because the clear definition of targets in the reflected light enables the bombardiers to use their bombing sights effectively, even from the high altitudes at which the defenders' antiaircraft forces them to fly. Furthermore, bright moonlight greatly nullifies the probing searchlight beams. On the darker nights, a favored practice is for the raiders to attempt lighting up the landscape with high-powered parachute flares. While this works in some instances, in just as many cases it is not successful. The

Planes for night combat must have about the same qualities as daytime fighters, with most emphasis on fire power and good landing behavior on blacked-out fields. One that fills the bill is the Republic YP-43, a single-engined, single-seat pursuit job shown in the drawing

POPULAR SCIENCE

Warplanes Fight at Night

flares tend to burst too high up and burn out before they drop low enough to reveal the objective; when they burst close enough to be effective the defenders can usually shoot them out.

Where the antiaircraft fire is particularly hot, incendiaries are used as markers. The fighter-bombers dive low enough to distinguish the target, relying upon their speed and maneuverability to foil the AA guns and searchlights, and drop thermite-oil bombs. The heavy and medium bombers higher up are then able to unload their eggs on the blazing targets. This, too, works exceedingly well for a while—until the fire brigades and civilians are organized to pounce upon and extinguish the incendiaries as they fall. When this happens, the attackers resort to a combination of demolition and fire bombs, hoping thereby to kill or frighten off the vigilantes on the rooftops or in the streets.

Pattern bombing from high-flying formations under radio control is another interesting and deadly technique. High-frequency beams, much like those which guide our airliners through the night along the invisible airways, are projected by the attackers over the city or area to be bombed, and these are crossed over—directly above the chosen objective—by other beams directed on an angular bearing from points far removed from the transmitters of the guiding beams. The attacking pilots follow the latter beams from the time of take-off until they intersect the second, or marker beam, at which time they know themselves to be over the spot. The bombs are then released "in salvo," dumped en masse, from altitudes well above the reach of the defender's AA and searchlights.

Even this ingenious scheme can be thwarted, and the bombees exploit every countermeasure. With equally ingenious gadgets, they proceed to "scramble" the beams so that the enemy airmen receive a lot of static and no further guidance. The beams may also be "bent" in such a manner that the bombers are led through an open switch, as it were, and off course to some point over open country or water where the missiles can do little or no harm. To accomplish this, the defenders resort to the simple expedient of emitting a beam of their own, on the same frequency as the enemy's, to intersect his somewhere along the line. It may be readily understood, how-

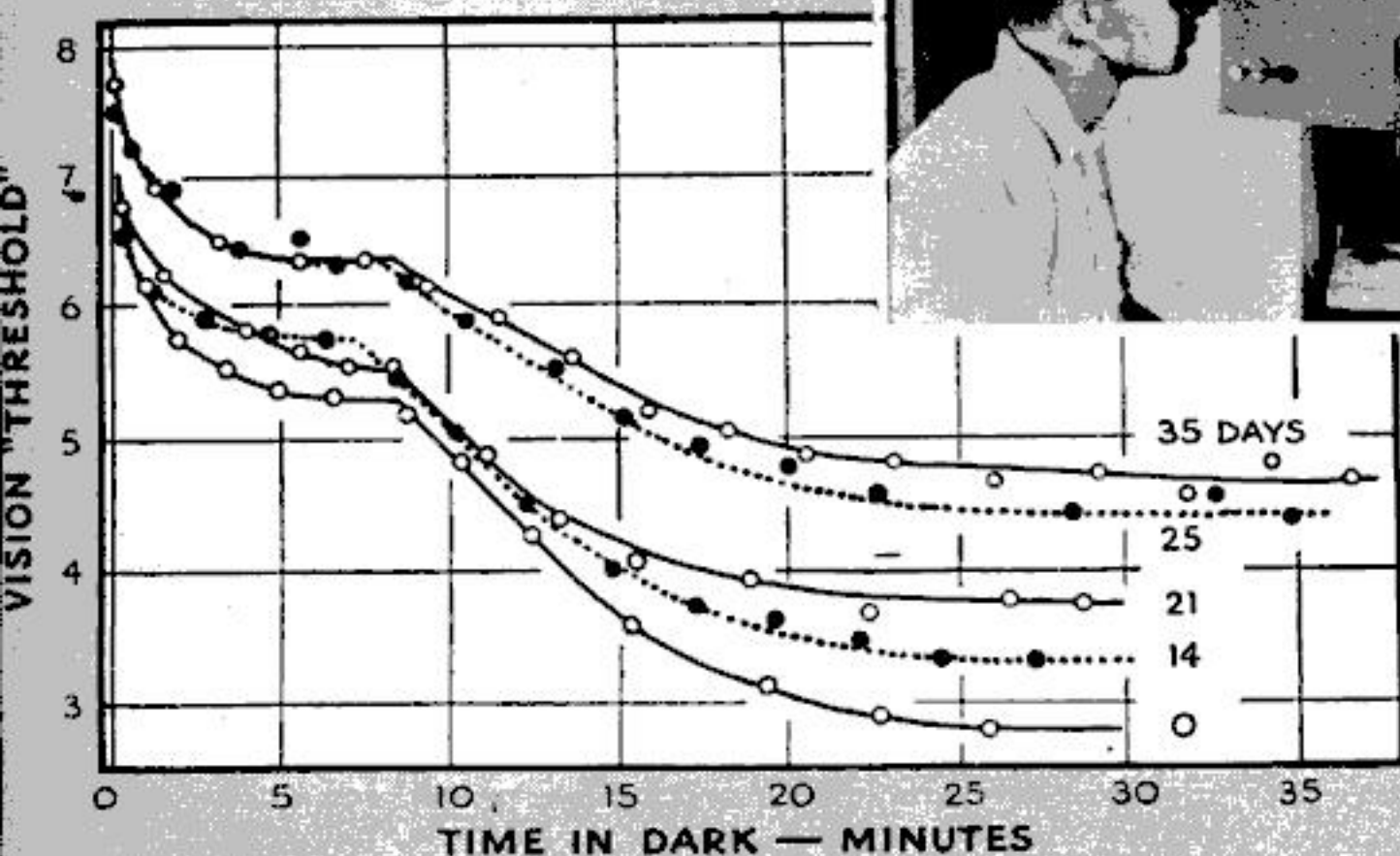
ever, why the riddle of the night bomber is far too complex a problem to be permanently solved so easily. Because one of the principles of warfare—ground or aerial—is that the element of surprise must be continually sought by the offensive striking force, the night bomber is still the military "big stick."

But another axiom of war is that a new weapon is five times as hard to conceive and bring into successful operation as is the counterweapon to neutralize it. Through the combination of several interesting devices, the United States is well along with the solution of the problem of the night bomber at this writing. These defenses may be classified as direct and indirect. The only direct defense against the bombing plane is the interceptor plane, and it is most certainly the most successful neutralizer. The indirect defenses may be considered as passive and active. Devices such as camouflage, blackouts, and even the balloon barrage go into the former category. For lack of space, let us consider the active measures.

The increasing effectiveness of antiaircraft is the result of the development of clever fire-control gadgets and of the stepped-up firing rate and longer reach provided by today's gun designers. These AA guns are of three general types: The rapid-firing cannon which throws shrapnel shells in the paths of high-flying bombers, the pom-poms or automatic shell cannon used to supplement the longer-range guns against raiders flying lower than 6,000 feet, and the machine gun for inside defense against low-flying craft in general and attack planes and dive bombers in particular.

Defenders manning the automatic guns can, with fair success, draw a bead on the enemy craft or throw up a curtain barrage in front of the raiders. But because too many corrections must be made for the high-flying bomber's speed, altitude, distance, and other factors, the men behind the heavy guns have to depend upon fire-control instruments. These include the mechanical "ear" or detector, used to determine the direction of approach; the range-finder, through which the enemy plane is spotted and its altitude (in vertical yards) ascertained; and the predictor, which assimilates prior information and computes automatically and continuously the data (such as the plane's speed,

Night-Fighting Flyers Must Have Cats' Eyes, and Vitamins Help Them to See in the Darkness



Testing a subject for "dark adaptation." A diet rich in vitamin A speeds up this adjustment of the eyes to darkness. Or. chart at left, curves show how deficiency of this vitamin for various periods of time affects night vision

distance, drift, and recommended ballistic corrections) the gunners and cannoneers require before going into action and during the action. After sunset, the defenders are confronted by two enemies—their adversaries and the darkness. Searchlights are, of course, necessary to spot the raiders and permit the range-finder and predictor operators to carry on. A coördinating gadget known as a "comparator" is connected with both the "ear" and the lights. Supplied the approximate bearing of the approaching ships, the comparator aims the lights and moves them in systematically widening circles until the enemy is sighted.

The searchlight has its limitations, however. Ours are admittedly the finest in the world, emanate some 800,000,000 candle-power, but even these suns on wheels are not effective against craft flying higher than 12,000 feet. Anything between a half and full moon cuts down the beam proportionately. What the gun crew can't see they can't hit, unless their luck is running pretty high. And it takes more than luck to stop a bomber speeding through the blackness of three dimensions. The night fighter, aided by two remarkable electrical devices and the indirect defenses mentioned,

is the ace that is neatly turning the trick.

Constant air patrol of one's coastlines is impractical because of the prohibitive number of aircraft and personnel required and the great expenditure of valuable fuel. Interception of enemy craft in the darkness is much too dependent upon chance, as is also the pilot's ability to keep hostile planes within view if and when they are engaged in combat. How is it accomplished?

The first essential is an efficient ground control and dispatching organization. The Army Air Corps and Signal Corps have developed a clever method involving the use of a new electric plotting board. These goings-on are, for obvious reasons, very much under wraps, but the British have developed a somewhat similar plan which it might be well to study.

The nerve center of their operations scheme is the Fighter Command Headquarters whose job it is to coördinate enemy information and dispatch the night fighters accordingly. The Isles are divided into "sectors," in each of which are one or more airdromes accommodating a fighter squadron. Each sector is furnished its own headquarters and operations room—a large room taken up almost completely by a scale

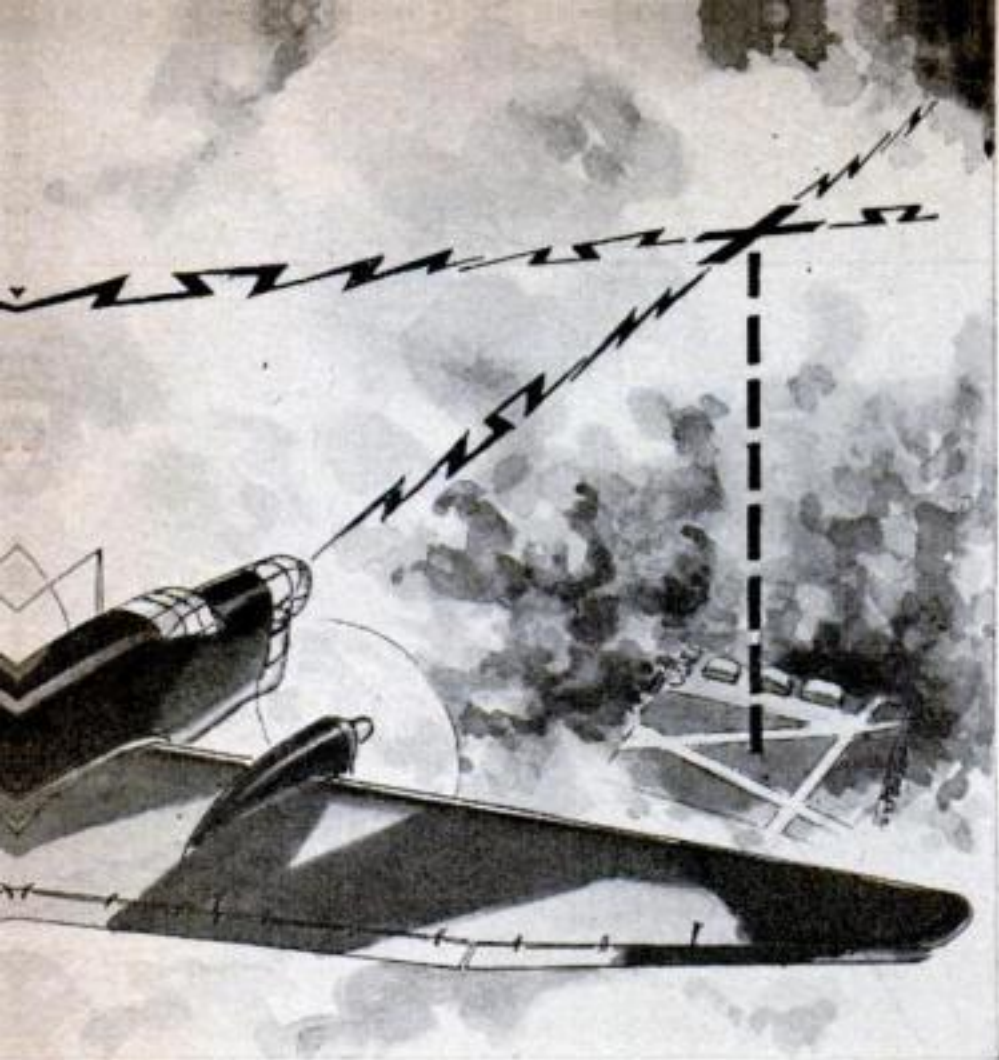


BLACKOUTS IN REVERSE have been proposed as a new wrinkle in antiaircraft defense. Under this scheme, searchlights and parachute flares would be used to produce a glare to blind enemy bombers

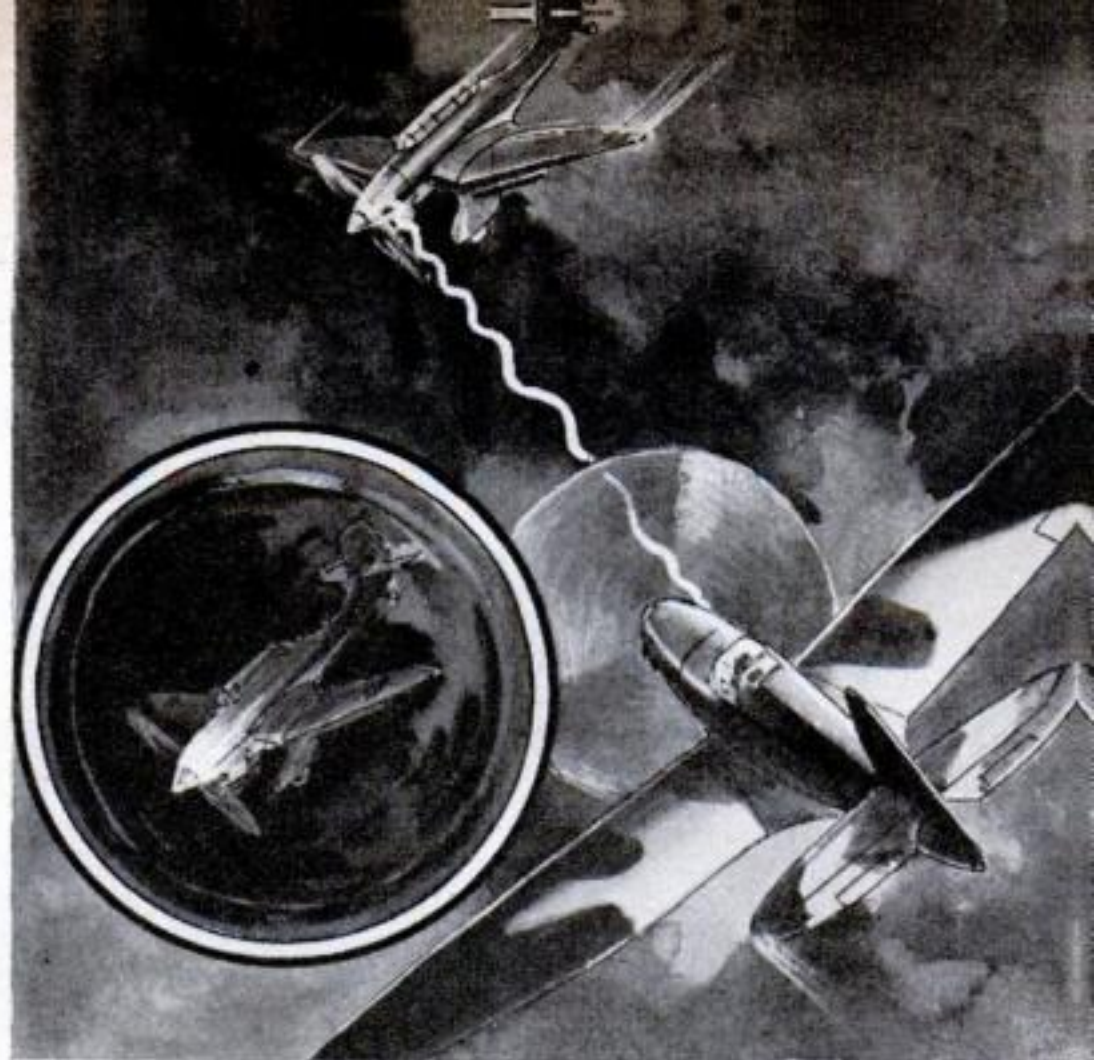
table map representing sections of the Isles and the surrounding sea area and enemy coasts on which an officer known as the "controller" plots the air action. Several junior commands called "groups" comprise a number of these sectors.

The scheme works this way: The radio locators—of which more will be said short-

ly—of a couple of the coastal stations of the Observer Corps detect a number of approaching bombers. Word is flashed to the Fighter Command. The controller here immediately advises group operations to order all the squadrons in the sectors within that particular group to "stand by," which means that the pilots are seated in their

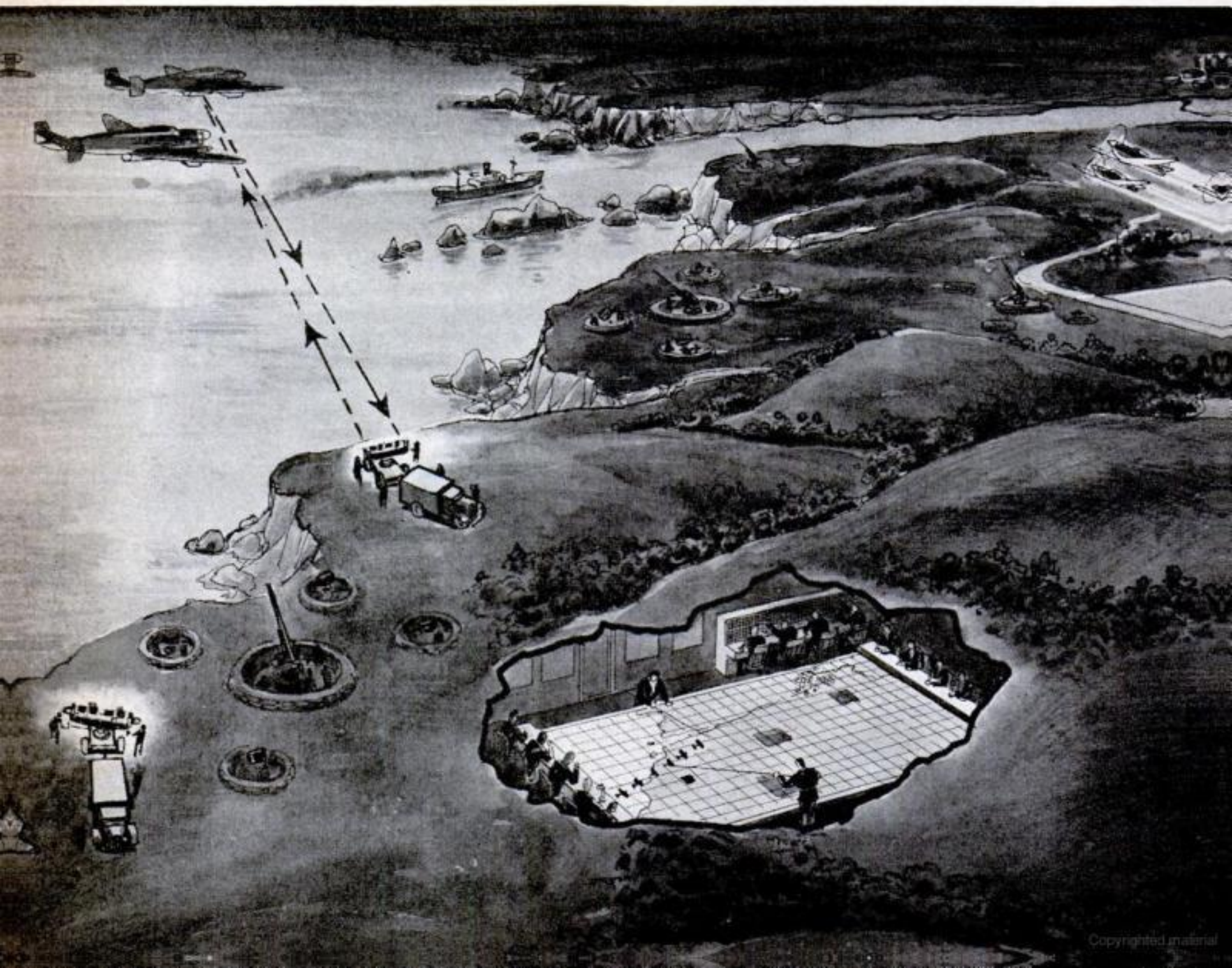


In pattern bombing, planes are guided by radio beams that cross above the target. Following one beam, the bomber dumps its eggs "in salvo" when it strikes the intersecting beam from another station



One of the devices that help fighter planes spot their prey in the dark is the "A-eye," in which the infrared rays from the engine of the enemy plane are made to cast an image on a fluorescent screen

HOW GROUND CONTROL CAN GUARD A COASTLINE. Radio locators set up along the shore spot approaching bombers and flash word to the control center, which warns fighter squadrons in the area to "stand by," ready to fly



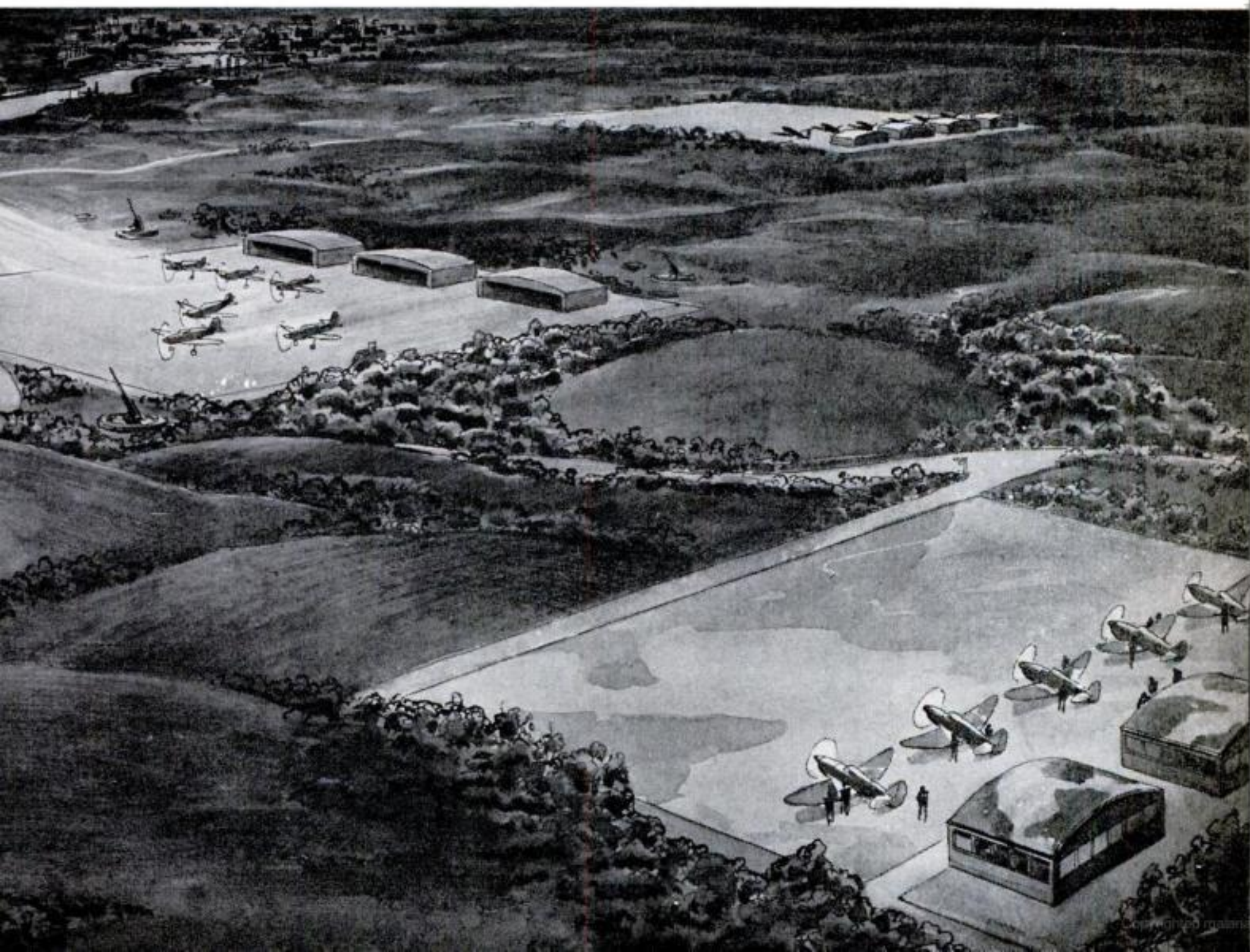
warmed-up fighters, ready to take off on signal. The fighters in the sector nearest, or on the line of the approaching raiders, are ordered up. Meanwhile, the squadrons in adjacent sectors stand by, and others under the group control are held "in readiness," with the pilots fully dressed and close by their ships. More of the squadrons farther inland are held "available," ready to take off within a few minutes of the order.

To keep from being caught off base, in the event of ensuing waves of bombers or a number of simultaneous raids at scattered points and so that the fighters aloft may be relieved before they run out of fuel and ammunition, operations are staggered. When the first squadrons are sent up, those in readiness are moved up to stand by; those held available are placed in a state of readiness; and others which have been released from duty are called up so as to be available. Controllers in the three respective operations rooms list the fighter units on blackboards according to the degree of their "alert." In this manner, each controller is able to tell at a glance just who is doing what.

As fighters along the path of the approaching raiders are ordered up, those in adjacent sectors stand by, while units farther away are "in readiness" with their pilots on hand. Meanwhile, squadrons far inland are ordered to be "available" in case they are needed

From the moment the raiders are first reported, their course is traced on the huge table maps and progress is noted by moving markers along the course. Antiaircraft units and the balloon-barrage units are meanwhile advised of the enemy's whereabouts. As soon as the fighter unit which has been ordered aloft has gained altitude, the controller radios the squadron leader to pursue a "vector," or heading, by which his fighters will intercept the raiders. The controller often advises the leader what cruising speed and altitude to maintain. When the fighter-squadron marker and the enemy marker meet each other, the controller notifies the leader of the bombers' proximity. As soon as the bombers are sighted, the leader gives the "enemy sighted" signal. Success, obviously, depends upon the accuracy of the controller's information. The radio locator is so accurate that it not only determines the bombers' course but also their speed and altitude.

Operating on the well-known principle that radio waves, upon striking some obstacle, are reflected in much the same manner as echoing sound waves, the interesting



gadget utilizes extremely short waves called "microwaves." Ultra-short waves provide a sharper echo. American airliners have, for some time, been using a terrain-clearance indicator which operates on the same principle. The locator might be described as one of these absolute altimeters in reverse; instead of the waves being projected down to the ground and bouncing up to the plane, the locator's beam is focussed upward, hits the enemy plane, and bounces back to the ground. The time interval between emission of the beam and the return of its echo is measured electrically and translated into feet of altitude. Radio waves, unlike the sound waves on which the anti-aircraft "ears" depend, travel at constant speed—the same speed as light waves, 186,000 miles per second.

Even more remarkable is another electrical contrivance which enables the pilots to spot the planes in the darkness. It is called the "A-eye" and utilizes infrared rays. Installation details may not be revealed at this time, but the general principle—which is well known to scientists the world over, and has been since 1934—is somewhat similar to that of television. There are two phases to its development.

Two highly sensitized screens are mounted on the night fighter in such position that they may be used in conjunction with the reflector gunsight. The front screen, a thin metal plate coated with a layer of caesi-ated oxidized silver, is sensitive to infrared radiation to about 11,000 angstrom units—3,000 units above the visual limit. When the image, resulting from infrared radiation of the enemy plane's motor, is caught on this screen, it emits a stream of electrons therefrom. This electron image, in turn, shows upon a second screen—a plate coated with a fluorescent compound, employing the same principle as the X-ray fluoroscope—and is turned into a distinct image of high illumination. This, however, results in the showing of too tiny a target for high-speed combat

planes, and there was also the probability of a pilot shooting at a friendly ship. This condition led to the second phase of development. The "A-eye," fortunately, is sensitive to objects reflecting infrared rays as well as those radiating the rays, and an infrared searchlight was developed which was compact enough to be carried in a plane. When used in conjunction with the eye and sight, it permits the pilot to "lay" the whole plane, or more than one plane and be certain of its identity. This is all that is required, since the size of the enemy plane—indicated by the amount of space the image occupies in the reflector disk—reveals its distance away from the pilot. In addition to this device, we have a secret anti-aircraft detector which works on the same principle.

One of the most interesting aspects of night defense is that involving the human element. The conditioning of airmen for night fighting has much to do with successful operations. The first task of the medicos is to carefully select pilots and gunners who are not subject to "night blindness." More than a few of the crack fliers, particularly those older than 25 years, whose vision proves adequate for daytime operations are found to have poor "dark

adaptation." This is the process by which the eyes accustom themselves to darkness; a common phenomenon you experience when entering a theater from the bright daylight. If there happens to be little light on the screen at the time, it is somewhat difficult to find your seat. By the time you are ready to leave, however, there has taken place a change and you can see perfectly well. What happens is that the vision thresholds diminish gradually for about half an hour, after which time one's ability to see in the dark is at the maximum.

Conditioning of airmen is commenced immediately following the selection of those who are found to have adequate dark adaptation. They maintain a (Continued on page 220)



Camouflage: This worker is spraying the blades of a propeller with a paint that keeps it from reflecting light at night

"Nerve Center" Guards New York

ARMY AIR CORPS SETS UP ELABORATE DEFENSE SYSTEM

AMERICA'S most elaborate air-defense information center has just been completed in New York City. It is the best equipped in the world. Minute-by-minute reports from more than 6,000 field observers will enable Air Corps experts, working at tables that resemble pieces from a giant jig-saw puzzle, to plot the progress of enemy bombers and to direct the swift climb and attack of interceptor planes.

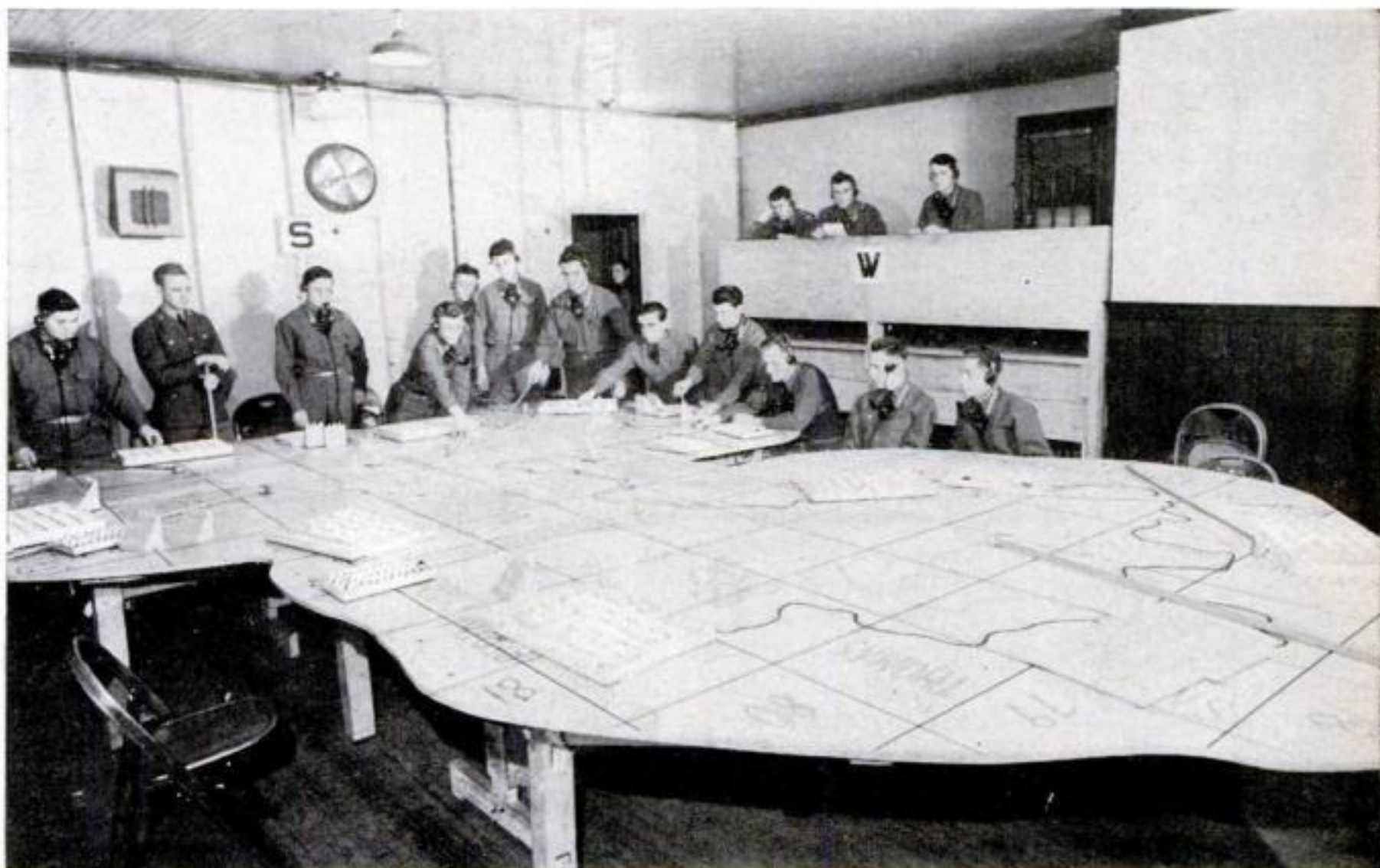
Even before the bombers reach the coast,

the Army's latest locator system will spot their position and, as soon as they wing inland, observers at five-mile intervals will flash in their reports—giving the type, number, height, and direction of the invading planes. As each flash reaches the New York nerve center, a marker, known as a "plotter's pip," will be placed on one of the jig-saw tables at a point that coincides with the position of the reporting observer. The table is called the "filter board" because here mistaken reports are filtered out. The men who place the markers on the board are designated "plotters."

Behind the plotters stand the "evaluators." As soon as these trained Air Corps men decide the course the invaders are taking, they replace the pips with arrows—colored red, blue, or yellow, according to the time of the hour the reports are received. Instantly, "tellers," sitting in a balcony overlooking the board, speak into tele-



On the status board, the location and condition of every defense plane is recorded. Below is a filter board, a giant table map on which plotters place "pips" to indicate places from which bombers are reported

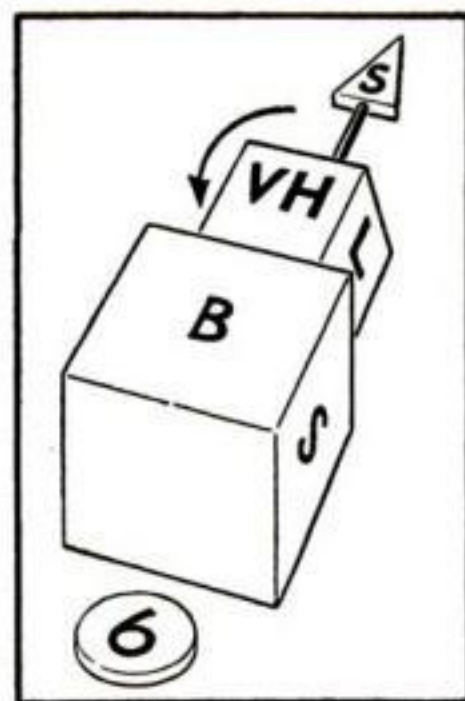
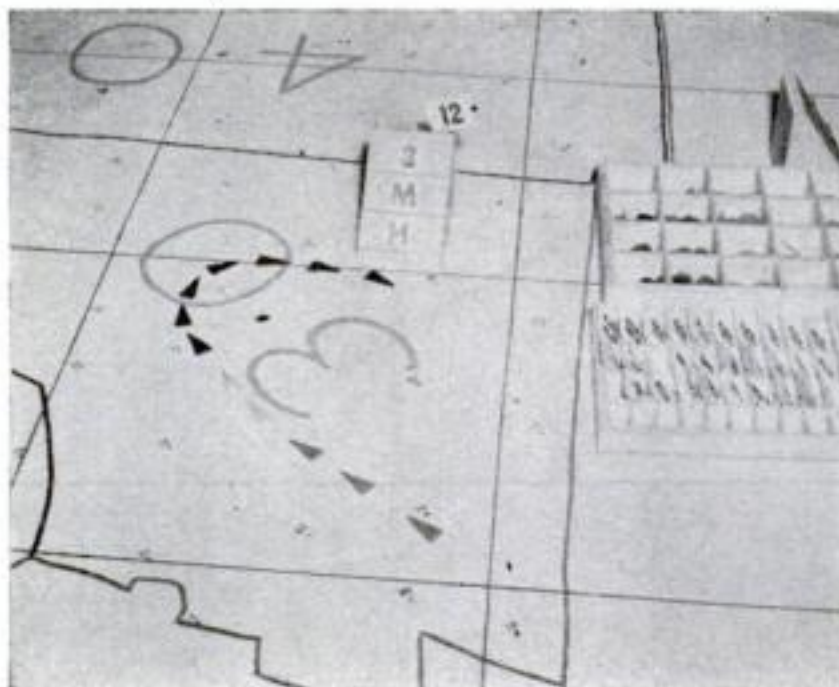




How experts would filter reports of enemy raiders and set in motion all the complicated machinery of aerial defense to protect a vital industrial area

This is an operations board. Here the course of the raiders is shown by arrowhead markers of blue, red, or yellow. The color of the markers is determined by the time of the hour a report was received

Close-up of a section of the board. A group of enemy planes, called a target, is given a number which appears on a block on the board



phones and similar arrows appear on a similar board in an adjoining room. This is the "operations board" from which final decisions are made.

There follows a swift succession of events. In a soundproof balcony overlooking the board, the controller, flanked by a pursuit officer and a radio control officer, assigns the invading "target" to one or more pursuit squadrons. In a matter of seconds, the complicated machinery of aerial defense is in full motion. Even before the interceptor planes begin skyrocketing up from the air field, pursuit officers in one of the six interceptor offices at the center are plotting the best course for engaging the enemy. These officers, in constant radio contact with the fighting planes, direct the whole attack from the ground. When plotting their navigation charts, they use colored pencils, changing every five minutes to coincide with changes in the color of the arrows on the operations board.

While this activity is going on, the civil air-raid warden is flashing out warnings to communities in the path of the attack; members of the intelligence division are

"Six bombers, flying very high, seen here, heading that way," is the information packed onto this plotter's pip. The disk gives the number; the cube, type of plane; five-sided block, the altitude; arrow, direction; letter on arrow, if seen or heard

noting down details of the raid for later study; officers of the First Interceptor Command, watching a third board in another room, are keeping track of developments and coördinating activity throughout an area that extends from Maine to below Cape Hatteras and from the Atlantic Coast as far west as Minnesota.

This vast area will be safeguarded by 13 information centers, each in a major city. Every center will have an auxiliary station ready to take over in less than eight minutes if the main center is destroyed or disabled. In New York, for example, is located the auxiliary filter board for Scranton, Pa. In all parts of the country, air defense nerve centers, similar to the one in New York City, are under construction. In the near future, between 30 and 40 will stand guard, fully equipped for emergencies.

1. HEREIN DOXKD CEK BIFIES MEDDHOE3
FROM OBSERVERS

1A. ALTERNATE FILTER BOARD
(SCRANTON, PA., AREA)

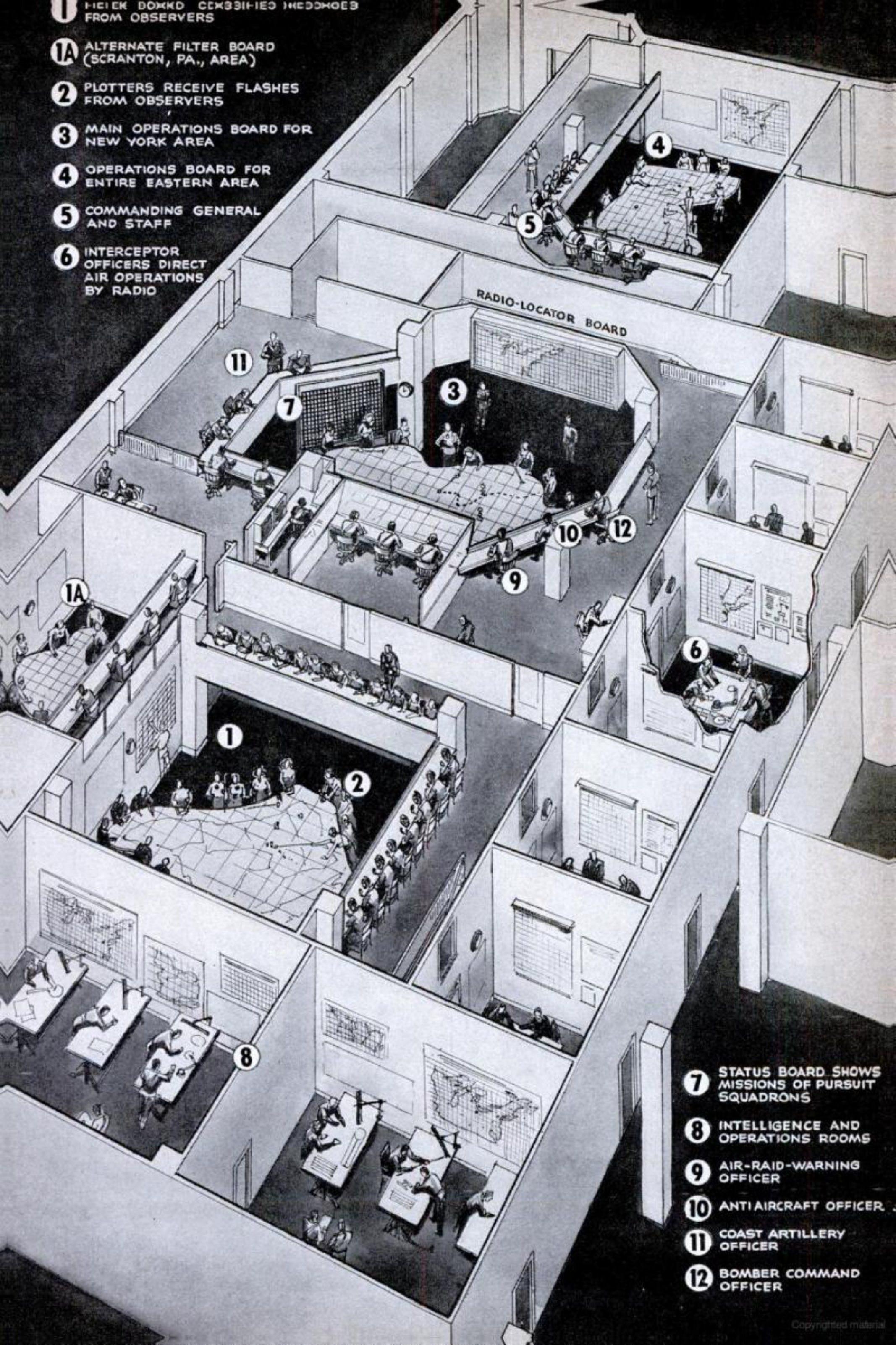
2. PLOTTERS RECEIVE FLASHES
FROM OBSERVERS

3. MAIN OPERATIONS BOARD FOR
NEW YORK AREA

4. OPERATIONS BOARD FOR
ENTIRE EASTERN AREA

5. COMMANDING GENERAL
AND STAFF

6. INTERCEPTOR
OFFICERS DIRECT
AIR OPERATIONS
BY RADIO



RADIO-LOCATOR BOARD

7. STATUS BOARD SHOWS
MISSIONS OF PURSUIT
SQUADRONS

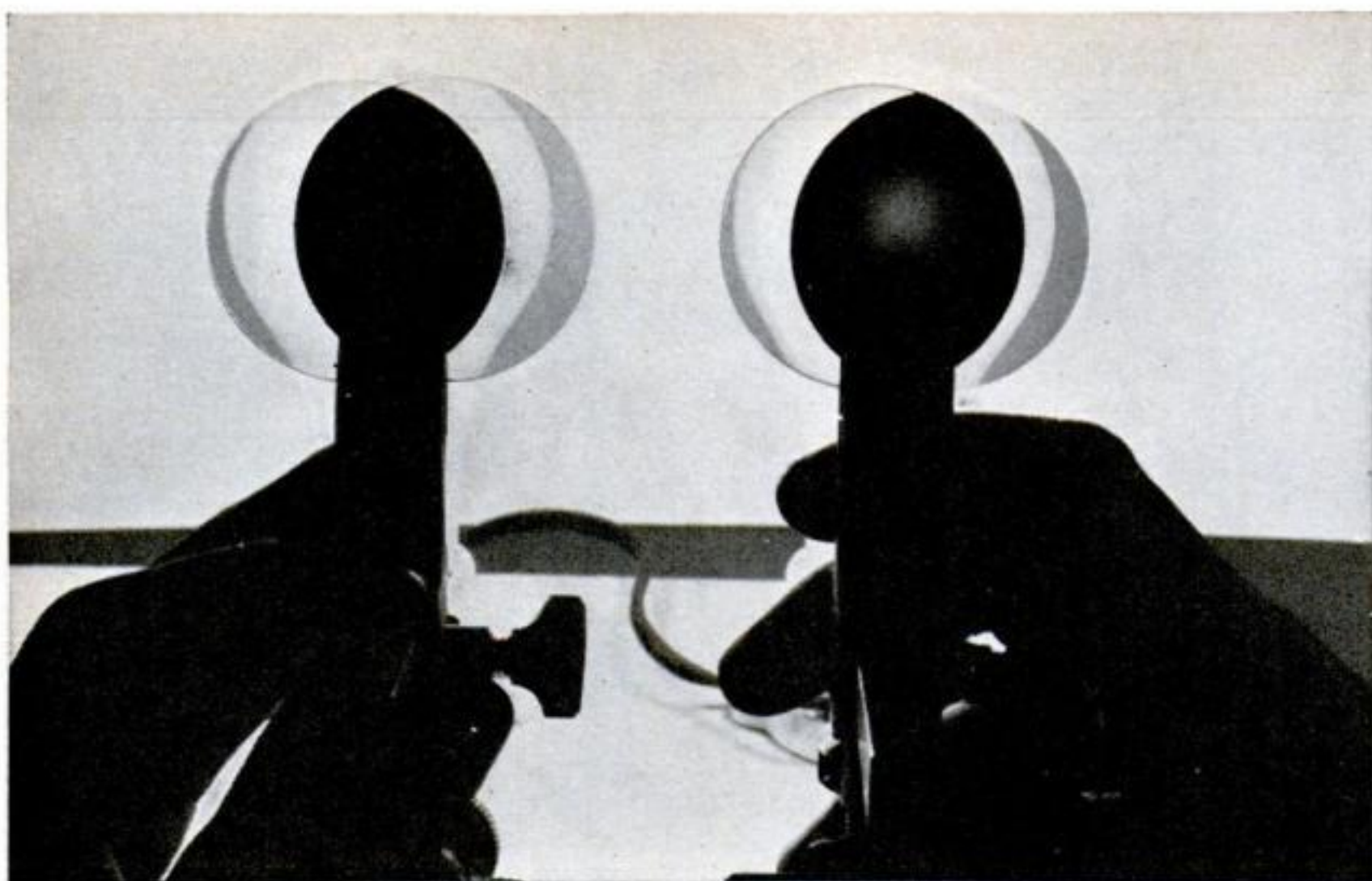
8. INTELLIGENCE AND
OPERATIONS ROOMS

9. AIR-RAID-WARNING
OFFICER

10. ANTI AIRCRAFT OFFICER

11. COAST ARTILLERY
OFFICER

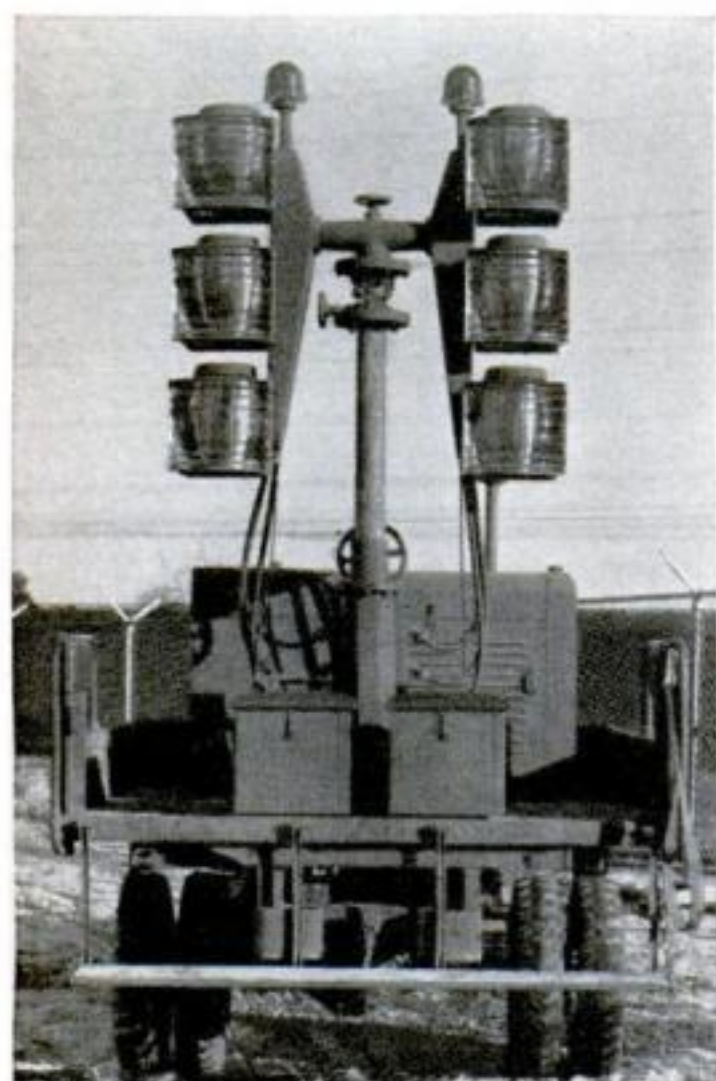
12. BOMBER COMMAND
OFFICER



Coke, Lime, Air, Water, and Iodine Make New Polarizer

MADE from such simple ingredients as coke, lime, air, water, and iodine, a new light-polarizing material, developed by Edwin Land, Boston scientist, uses individual molecules instead of crystals to line up light vibrations. Besides being virtually

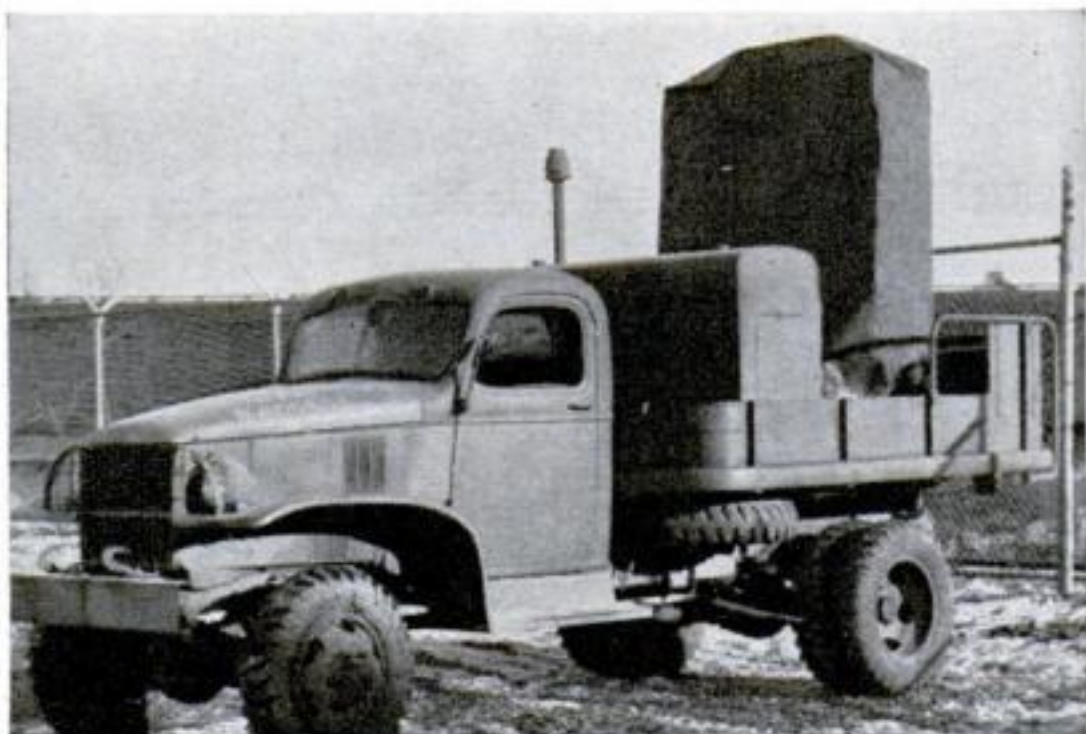
colorless, it transmits a third again as much light as earlier polarizing sheets, and at the same time cuts off more light when two sheets are turned at right angles to each other. In this position, a 100-watt bulb burning behind them is entirely invisible.



Power plant and floodlights on truck, above, provide eyes for night flyers. Right, covered over for dash to field

Mobile Floodlights Illuminate Emergency Landing Fields

PORTABLE floodlights, mounted on powerful, four-wheel-drive trucks, and equipped with hoods that prevent enemy flyers from seeing them, have been designed at Wright Field, Dayton, Ohio, for illuminating emergency fields for night take-offs and landings. Each truck carries six floodlights.



Priorities Hit Your Home

AND BRING A CROP OF SUBSTITUTES FOR WAR METALS



Metal washing-machine agitators like the one at the left, above, will be replaced by plastics. The new product, seen at the right, is said to be lighter, smoother, and less subject to corrosion.

By JOHN WATSON

THE mounting production of bombs, bullets, shells, planes, ships, guns, rifles, tanks, and trucks has fashioned a chain, each link of which is forged of a different substance, across the normal course of American manufacturers of civilian products, forcing them to detour into strange and challenging by-roads.

Such strategic materials as aluminum, magnesium, nickel, and synthetic rubber are under the direct control of the Director of Priorities of the Office of Production Management. On the growing Priorities Critical List are such metals as tin, tungsten, zinc, brass, bronze, vanadium, various alloys of steel, and Monel metal—an alloy of nickel, copper, iron and manganese, resembling nickel.

These facts impinge directly or indirectly on the life of every American, whether a housewife

in Maine, a financier in New York, an industrialist in Pittsburgh, or an automobile dealer in Idaho. They are also a powerful shot in the arm to American inventive ability.

Exhibit A in this round-up is aluminum, the metal of a thousand and one civilian uses: cooking utensils, automobiles, refrigerators, vacuum cleaners, washing ma-

Plastics will make their appearance in fittings for more and more household appliances. There are 13 main types of plastics available and some 160,000,000 pounds are used annually



chines, recording disks, foil for cigarettes and cigars, insulation, caps and tubes for tooth-pastes and shaving creams, women's clothing accessories—to name just a few. A pound used to cost as little as a package of cigarettes, and the annual production in the United States approximates 400 million pounds.

A few months ago, the Government began to clamp down on the metal, but it was still believed that non-defense users might get 50 percent of their normal requirements this year. The O.P.M., for instance, decided that only one or two aluminum ice trays might be installed in the new refrigerators, depending on the size of the units. But there was no indication of all-out restriction.

Now observe what has happened. The needs of the British and the demands of national defense have increased beyond all anticipation. One single item which put an entirely new urgency on the problem was the development of the huge B-19 heavy bomber. Each B-19 bomber requires 80,000 pounds of aluminum.

William L. Batt, Deputy Director of the O.P.M., stated recently that the whole available supply of aluminum will be needed for defense purposes in 1942. None will be left for civilian or even indirect military requirements. If the B-19 bomber becomes a mass-production tactical weapon, the aluminum requirements for 1942 may be 1,400,000,000 pounds, by his estimate.

The Aluminum Company of America, which has been the sole producer of aluminum ingot, is engaged in a \$200,000,000 expansion program. Reynolds Metals Com-

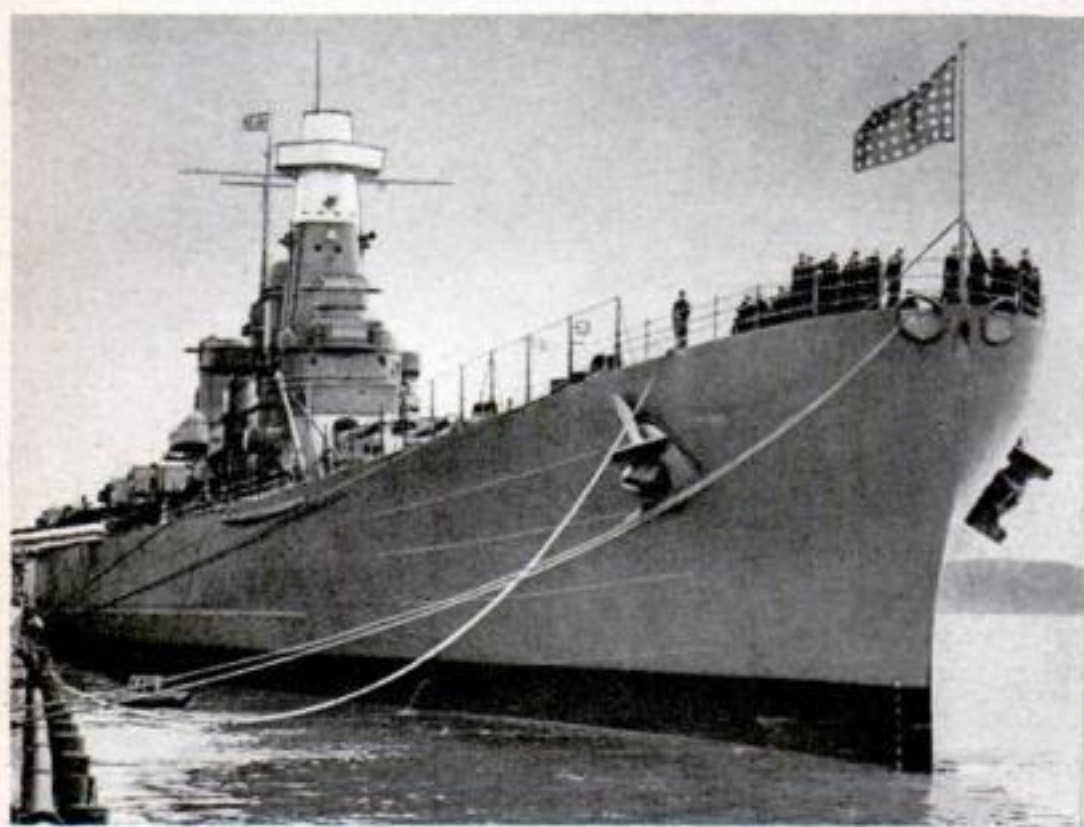
pany is spending \$35,000,000 on plants which will furnish a second supply source of virgin aluminum. Yet these expansions are not considered sufficient to care for the requirements of the defense program. Thus the aluminum situation, which only a few months ago was acute but not critical, has reached the point where the Government is considering a house-to-house campaign for old pots and pans.

In May of this year, the Government took over complete control of all nickel supplies in a move to curtail drastically the amount of the metal being used for other than defense purposes. Almost all of the United States supply of nickel comes from Canada, which produces 85 percent of the world's output. In May about 15,500,000 pounds were available, the largest amount ever supplied to American industry in one month. Yet the total demand of defense and civilian industry was estimated at 21 million pounds.

In spite of the increased imports it was estimated that the shortage for this calendar year would amount to 45 million pounds, and that while there would be sufficient nickel for defense needs the civilian industry would have to go short. This illuminates one of the problems of the American manufacturer in finding substitutes for civilian articles. Stainless steel suggests itself, as a substitute for aluminum cooking utensils, but nickel is an essential part of heat-resistant stainless steel.

Tin, while on the priorities critical list, has not reached the status of an emergency, but there has been considerable discussion on the feasibility of de-tinning cans and of

WHAT IT TAKES TO BUILD A BATTLESHIP



A LOT OF MATERIAL goes into the making of a battleship like the U.S.S. Washington. The 15 new battle wagons for our two-ocean navy will make a big dent in our available supplies

Steel	62,000,000	pounds
Copper	2,022,000	"
Tin	82,000	"
Zinc	1,030,000	"
Nickel	796,000	"
Wood	321,000	Bd. Ft.
Rubber	160,000	pounds
Cordage	11,000	"
Cotton	55,000	"
Aluminum	952,000	"
Mica	250	"

Standard Displacement.....	35,000 tons
Length.....	704 feet
Beam.....	108 feet
Mean Draft.....	26 feet 8 inches
Main Guns.....	9 16-inch
Aircraft	3
Designed Speed.....	27 knots
Designed Horsepower.....	115,000

SUBSTITUTIONS

methods other than the use of tin in coating steel containers for the preservation of food. Besides this use, for which 35,000 to 40,000 long tons of tin are used annually in the United States, the metal is used in the manufacture of automotive vehicles, in bearings, solders, bronzes, and gun metals.

A committee of the National Academy of Sciences has estimated that 12,000 tons of tin might be recovered annually by the de-tinning of used cans. But this is a costly and laborious process and should only be attempted, the committee recommended, in the event of emergency where conservation of tin was desirable without thought of cost. In the meantime, can manufacturers informed the O.P.M. that a ten-percent reduction in the weight of tin coating of cans could be made safely for about 95 percent of all tin-can uses. It is estimated that 5,000 to 10,000 tons of tin a year could be saved by a ten-percent reduction in weight of coating.

The Union Carbide and Carbon Company has produced, as a substitute for tin coating of cans, a vinyl resin lacquer. Lacquer coatings already are in use for dry packs such as tooth and talcum powders and tobacco. Some paint manufacturers are changing from tin-plated toterne-plated cans. Terne plate is made of tin and lead—requiring less tin than tin plate. Many foods can be packed in a transparent sheeting made from a rubber derivative.

Molybdenum, a metallic element of the chromium group, is being used to some extent as a substitute for nickel and tungsten in steel. Tungsten has a military use in the manufacture of armor-piercing projectiles, armor plates, and valves for internal-combustion engines.

Molybdenum alloys are being developed to replace tungsten for hard machine tools and tool makers have been asked to use molybdenum tool steels or other alloys whenever practical. The United States produces most of the world's supply of molybdenum. Molybdenum high-speed steels can be substituted for tungsten steels for most uses.

The automobile industry has long since undertaken to find substitutes for the metals on the restricted lists. Chrysler has been using straight molybdenum steel for some time, while General Motors is reported to be making a shift from nickel to molybdenum steels. Makers now using nickel as an alloy in valve, gear, axle, and transmission parts will be able to use molybdenum



AUTOMOBILES: Molybdenum or chrome steel replaces nickel steel; plastics supplant die-cast zinc or aluminum; cast-iron pistons, brake drums



BICYCLES: Frames, formerly made of steel tubing, will be of a laminated plastic plywood. Plastic accessories, and probably tires of synthetic rubber



CAMERAS: Your next camera will be likely to have a case of plastic instead of aluminum. And the film in it will be wound up on a spool of plastic



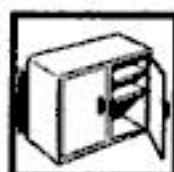
CHEWING GUM: No more tinfoil or aluminum-foil wrappers. Your favorite flavor will be kept fresh in a plastic wrapper, or one of paraffined paper



DINETTE TABLES: You won't see so many steel table tops now. They'll be made of light, strong laminated wood, coated with water-resistant finishes



FLY SCREENS: The ingredients of bronze are too scarce to waste on the job of keeping out flies. Windows and doors will have screening of plastic



KITCHEN CABINETS: Wood, almost driven out of this field, will stage a come-back, releasing a lot of steel needed for tanks, guns, and warships



RANGES AND HEATERS: The fancy chromium and nickel-steel trim formerly seen in the modern kitchen is to give way to decorations of cast resin



POTS AND PANS: Enamelware and heat-resisting glass will replace aluminum. Cast-iron skillets and roasters will also come back into general use



REFRIGERATORS: Ice trays will be made of tinned copper, steel, or plastic instead of aluminum. Handles and other fittings made of injection plastic



FOOD PACKING: Tin will be saved by coating cans with lacquer wherever possible. Many foods will be packed in a transparent sheeting made of rubber



VACUUM CLEANERS: Domes will be made of injection plastic instead of die-cast aluminum. Hose fittings, nozzles, and other parts also of plastics



WASHING MACHINES: Plastic agitators are cheaper than aluminum, and are said to be better. Clutch handles are of plastic instead of die-cast zinc

or chrome, after the necessary retooling and designing.

Zinc die castings, according to expectations of experts, virtually will disappear from 1942 models. Cast iron is being used as a substitute, even in carburetors, where die-casting has resulted in important savings in machining and drilling. Aluminum in brake cylinders and pistons is being replaced with cast iron for pistons and cast or powdered iron for brake cylinders. Plastic engine baffles in place of aluminum are now being service-tested, not only for automobiles but also in airplane construction. Laminated reinforced plastic material is being tried out for automobile bodies and structural parts of planes.

Experiments are being made with molded plastics as a substitute for zinc die castings. They are also being tried for carburetor bowls. There is a current shortage in zinc caused by the demand for this material for the making of cartridge brass. The production has been increased but the demand, as in the case of aluminum, is greatly ahead of it.

Three of the larger car makers already have produced sample cast-iron pistons and have placed orders for electroplating equipment with which to tin-plate the iron pistons.

The Ford Motor Company has announced it has made manufacturing changes which have resulted in savings of 80 percent in nickel, 50 percent in aluminum, and 50 percent in zinc. Straight chromium steel is being used in place of nickel chromium steel on bright metal trim; chromium molybdenum steel is being used instead of nickel bearing steel for transmission and differential gears.

Aluminum engine pistons have been replaced by steel pistons. Eight out of ten tractor parts now made out of aluminum will be changed to iron and other ferrous material. Aluminum time gears are being replaced by steel and bakelite gears. Aluminum cylinder heads, brake wheel pistons, valve-chamber covers, and distributor bodies are replaced by cast, die-cast, or powdered iron.

Zinc metal die-cast trimming, steering-post hub and brackets are being replaced by steel stampings. Instrument-panel

grilles, horn buttons, and interior metal trims are being replaced by plastics, and in some cases by bright-finished steel. Magnesium, being released by the Government only for defense purposes, is no longer used on any Ford commercial products.

Plastics comprise a vast and almost untapped reservoir of possible substitutes for defense metals. They are made synthetically of simple raw materials abundantly available in this country. As long as coal, oil, limestone, wood, and water are available, most of the plastics can be synthesized, although in commercial production many materials are now used as the start-

ing point of manufacture. Soybeans are a source of plastic materials, and coffee beans may become more important as a source of plastics than for beverage purposes.

Manufacturers of articles for civilian needs are turning to plastics to take the place of metals on the priorities lists. The refrigerator industry is using plastics in place of aluminum as a lining for refrigerator walls and doors, and for ice trays. Vacuum-cleaner manufacturers are turning to plas-

tics for hose fittings, nozzles, and end plates in cylinder-type cleaners. In one cleaner, seventeen sweeper and accessory parts are molded of resins.

Radio broadcasting companies, motion-picture companies, and other concerns which make permanent recordings on aluminum disks are investigating a substitute in a glass-base recording blank covered with an acetate coating. It is hoped that this new disk will release about a million pounds of aluminum a year for defense purposes.

A pump formerly made of metal parts now is made entirely of a phenolic type of plastic. Gunstocks formerly shaped out of walnut are being pressed from powdered plastics, which provide a stronger stock in a shorter time and at a lower cost.

American industry has always been able to meet any demands imposed upon it. New emergencies create new ideas; new ideas create new products; and new products create new markets. There is no reason to suppose that the chain of cause and effect which has functioned so effectively in the past will not continue to function in the future.



Products as varied as perfumes and lubricating oil are packaged in synthetic resin. Increased use of plastics will save needed metals

Dr. McCay and his assistant, Gladys Sperling, examine some of the rats he tests for diet and longevity in work he has been doing at Cornell eight years



By EDWIN TEALE

Stay Hungry and Live Longer

Tests with 2,500 Rats Show That What You Eat Isn't So Important an Aid to Longevity as How Much

IF ANY man in America can look at your dinner plate and tell you how long you are likely to live, it is Dr. Clive M. McCay, of Cornell University. For eight years, he has been carrying on pioneer researches in diet and longevity. Hungry people, Dr. McCay has found, live longest—if they are not too hungry.

A diet that contains all needed essentials in reduced quantities is, next to long-lived ancestors, the greatest aid to longevity. Partial starvation, keeping you thin but not too thin, will add years to your life. This is the conclusion of experiments with more than 2,500 white rats at Dr. McCay's Cornell laboratory. These animals were chosen for the re-



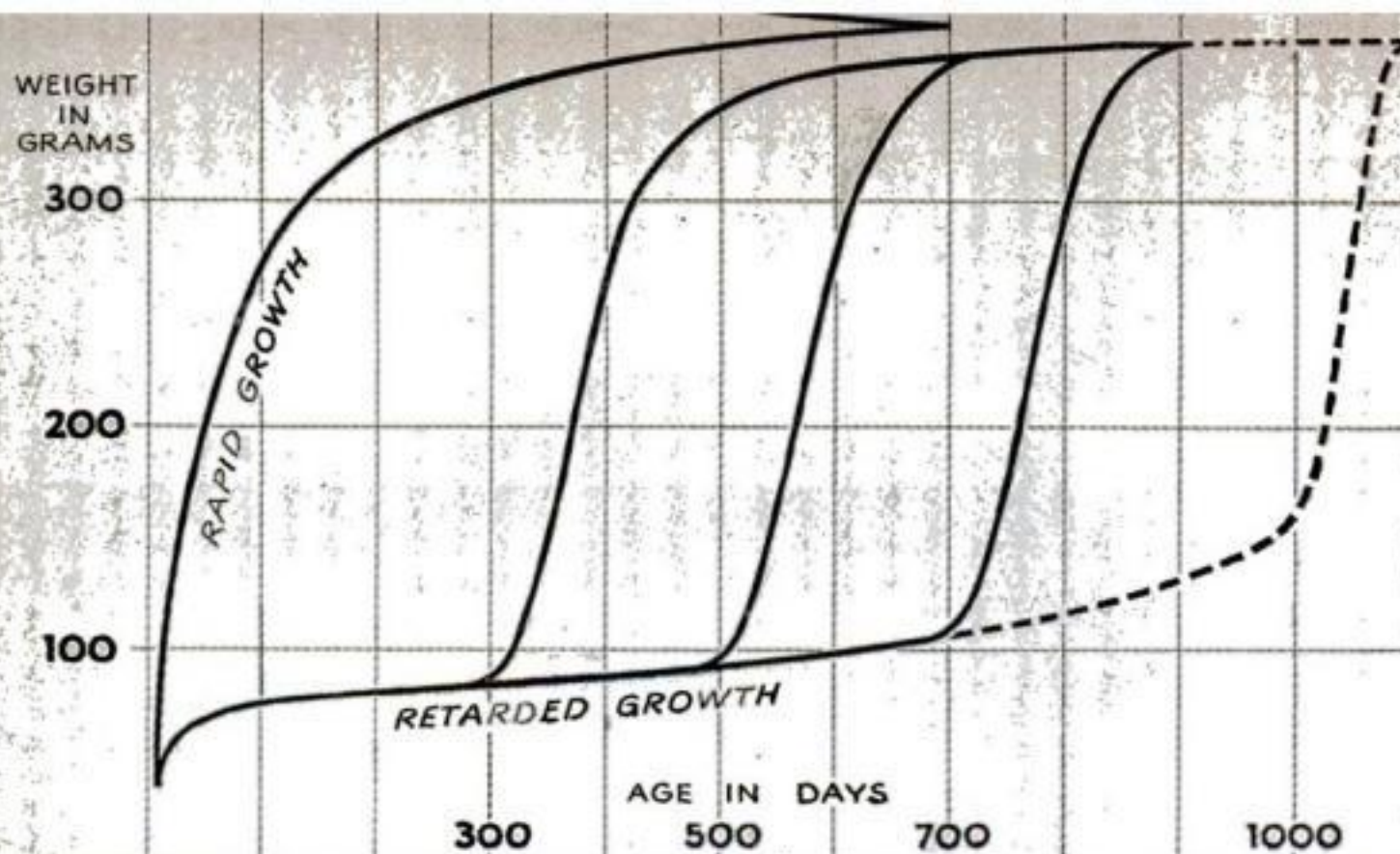
RAT LIFE IS A SPEED-UP OF HUMAN LIFE
Ten days in the life of a rat is equal to about a year in a man's. So in 800 days, scientists can see the results of 80 years of diet in a human



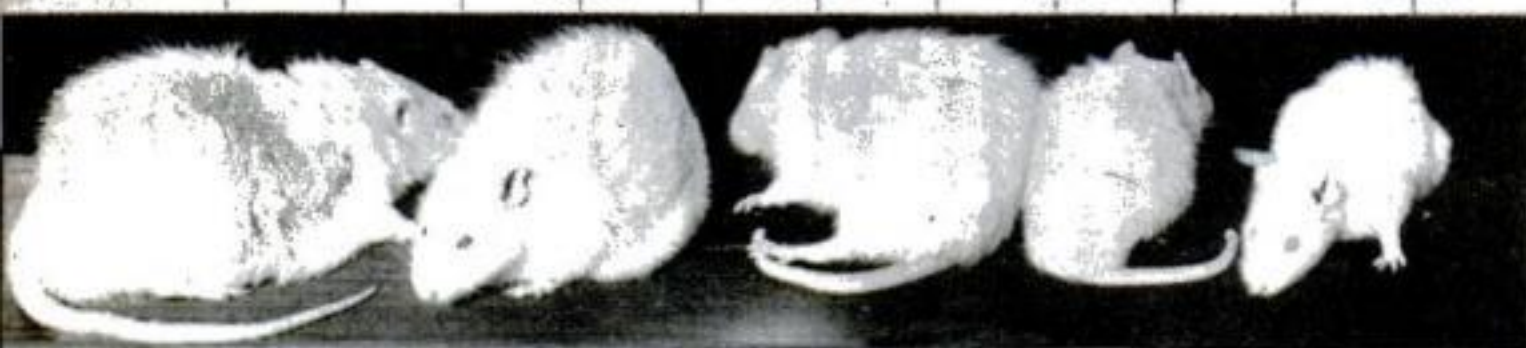
RATS THAT LIVE HIGH, eating all they want, are old and ready to die at the age of 700 days, which equals the proverbial "three score and ten" years allotted to humans



RATS THAT GO HUNGRY, receiving only half the normal food ration in a balanced diet, are still going strong at 700 days. Underfeeding is found to slow down the vital functions and so prolong life



Retarded rats gain in weight and "grow up," as chart shows, when fed excess calories. This occurs even after they have attained an age equivalent to that of a man 80 years old. One underfed rat lived to an age of 1,430 days



To determine whether exercise has an effect on longevity, rats go into revolving barrels. Electric charge in wire screens at ends shocks those that try to climb on them to get a ride

searches because they react to diet in the same manner as humans and because, roughly, ten days in the life of a rat is equal to one year in the life of a man.

All the animals were fed a basal diet consisting of casein, cornstarch, cod-liver oil, yeast, sugar, lard, alfalfa-leaf meal, liver, and roughage in the form of ground cellulose. The rats that received only half the rations ordinarily fed lived longest. Their starvation diet slowed down the vital activity of the body. There were fewer white corpuscles in their bloodstream, and their hearts beat only 300 palpitations a minute instead of the 400 beats of the well-fed rat. Thus, living more slowly, saving energy, the underfed animals had increased longevity. Their brains, however, seemed more alert. Brain activity speeded up while body activity slowed down.

In one experiment, which ended in a surprising discovery, 200 middle-aged rats were divided into four groups of 50 each. All had been raised in the same room under identical conditions. All had been fed the same basal diet, supplying essential elements in reduced quantities. All were approximately 40 years old, in human-life terms, when the test began. In the experiment, one group was fed excess calories in the form of sugar, another in the form of starch, a third in the form of whole-milk powder, and the fourth group in the form of liver.

What Dr. McCay wanted to know was whether excess in one kind of food will shorten life more than excess in other kinds or, to put it another way, whether there are

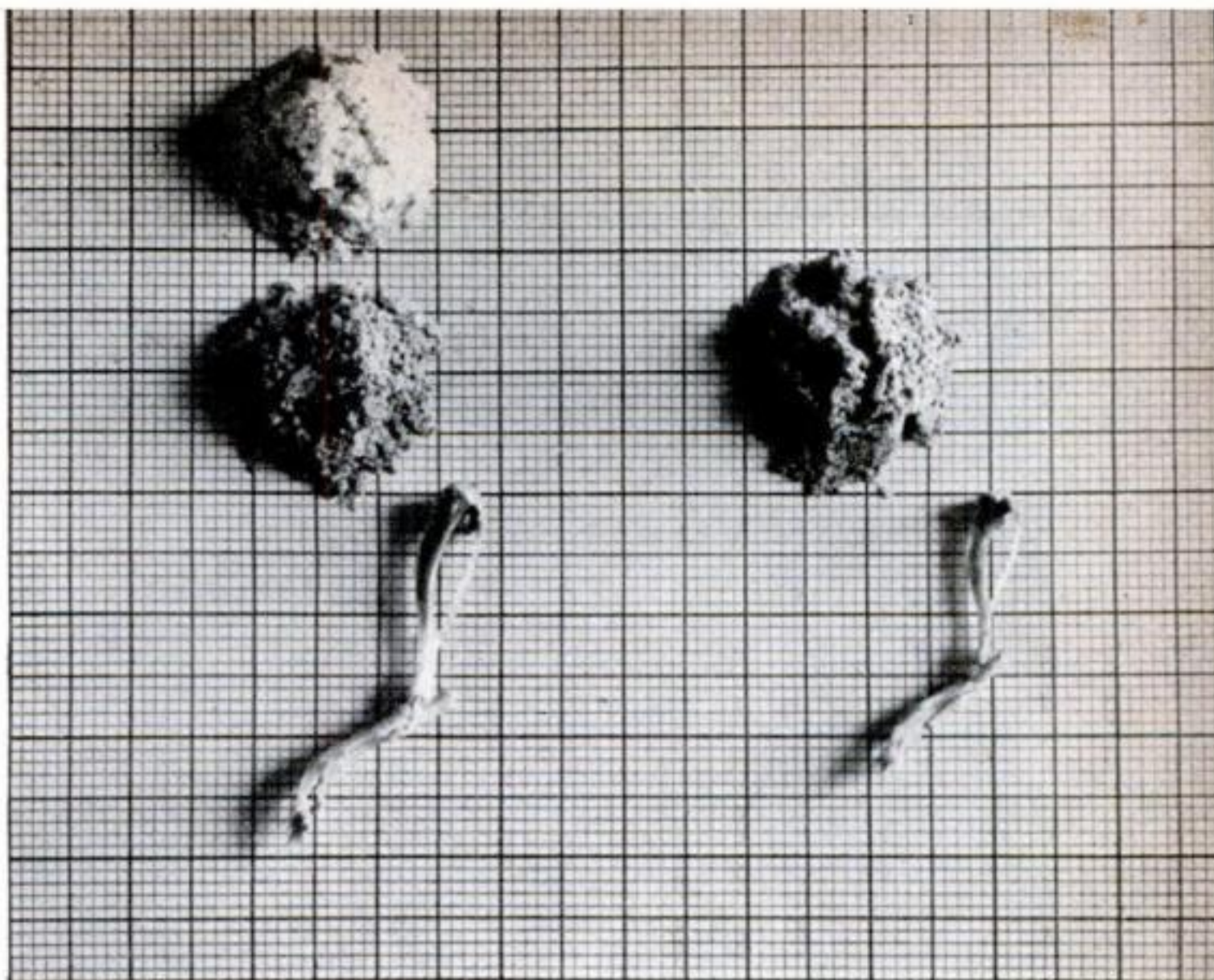


"longevity foods" that will add to the life span of those who eat them. The test gave a negative answer to both questions. All four groups lived approximately the same length of time. And all the animals died much sooner than they would have if they had continued on reduced rations. Over-eating, no matter what you eat, affects longevity adversely.

A by-product of the test, however, was the discovery that animals which received their excess calories in milk or liver remained fertile twice as long as those that overate in sugar or starch. The former

Leg bone shown at left is that of a rat fed a basal diet plus extra calories, compared with similar leg bone of a rat that was retarded by receiving only the basal diet. Amount of food rationed to each shown above the bones

Every rat has his food cup which is sterilized after use. Carefully measured food, put in individual containers, is carried to them in the rack by Dr. McCay's laboratory assistants



were still fertile at 600 days; the latter were sterile at 300.

Other questions answered by the Cornell experiments are: Does the protein content of the diet affect longevity? Does roughage play an important role? Is exercise a factor? During the eight years he has been carrying on his researches, Dr. McCay reports, he has not found a single indication that a high or low-protein diet is a factor of any importance in longevity. Previously, many scientists had been of the opinion that a high-protein diet, such as would be produced by consuming meat, shortened

the span of life. Exercise, likewise, according to the evidence of Dr. McCay's experiments, plays only a minor role. Among the 3½ tons of food given the Cornell rats annually, roughage—in the form of bran or ground cellulose—has been added in varying quantities to the diet of different groups. Such additions produced no noticeable effects on longevity.

A question Dr. McCay is often asked is: If partial starvation increases the span of life, why are not the Chinese, who have been underfed for generations, the longest-lived race on earth? The answer is that their restricted diet lacks essential elements. The underfed rats at Cornell receive carefully balanced rations that meet the needs of health. Although these animals remain small when fed only half the normal quantity of food, they are in perfect health. At the end of 800 or even 1,000 days—the equivalent of 80 or 100 years of human life—these retarded rats will grow up and attain almost full size if they are fed increased calories. The Methuselah of the Cornell laboratory was one underfed rodent with a life span of 1,430 days. It lived as long, proportionately, as a man would be reaching the age of 143 years.

So important is Dr. McCay's work on diet and longevity considered that the Rockefeller Foundation recently granted \$60,000 for the continuation of his researches. His findings, to date, he sums up by revising an old health adage:

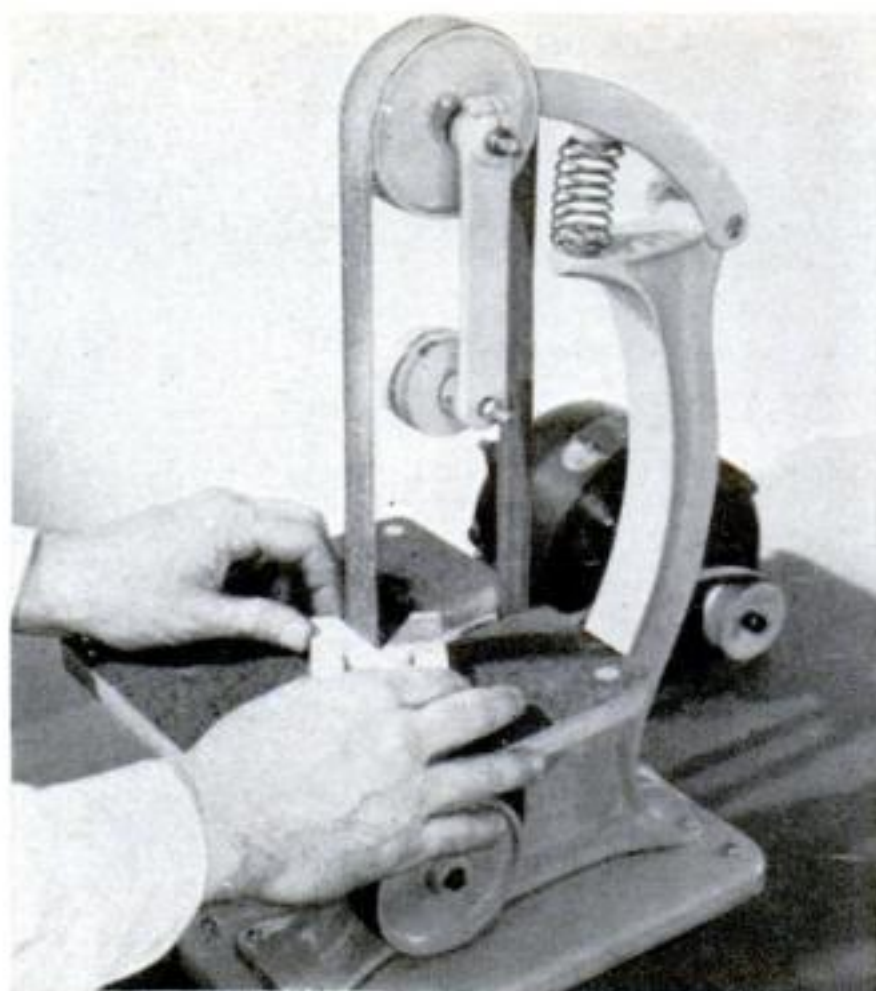
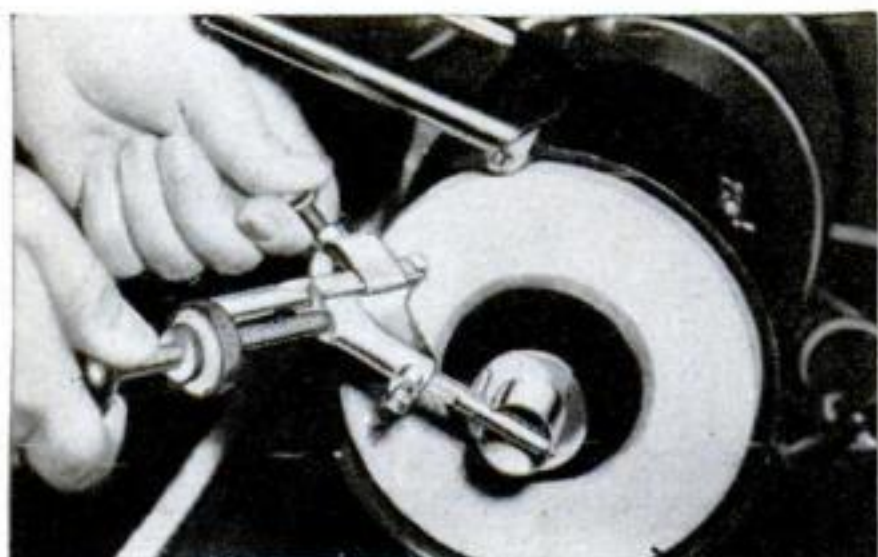
"Eat what you ought to eat first; then eat what you want to eat—but not too much of it!"

New Tools

REVERSIBLE AND INTERCHANGEABLE BLADES adapt the screw driver shown below for use with either slotted-head or recessed-head screws. One end of each blade is ground to fit each type of screw head, and the blades slip into a socket in the shockproof plastic handle. Blades and handles come in varying sizes to fit almost any size of screw. A tamperproof compression spring holds blades in place.

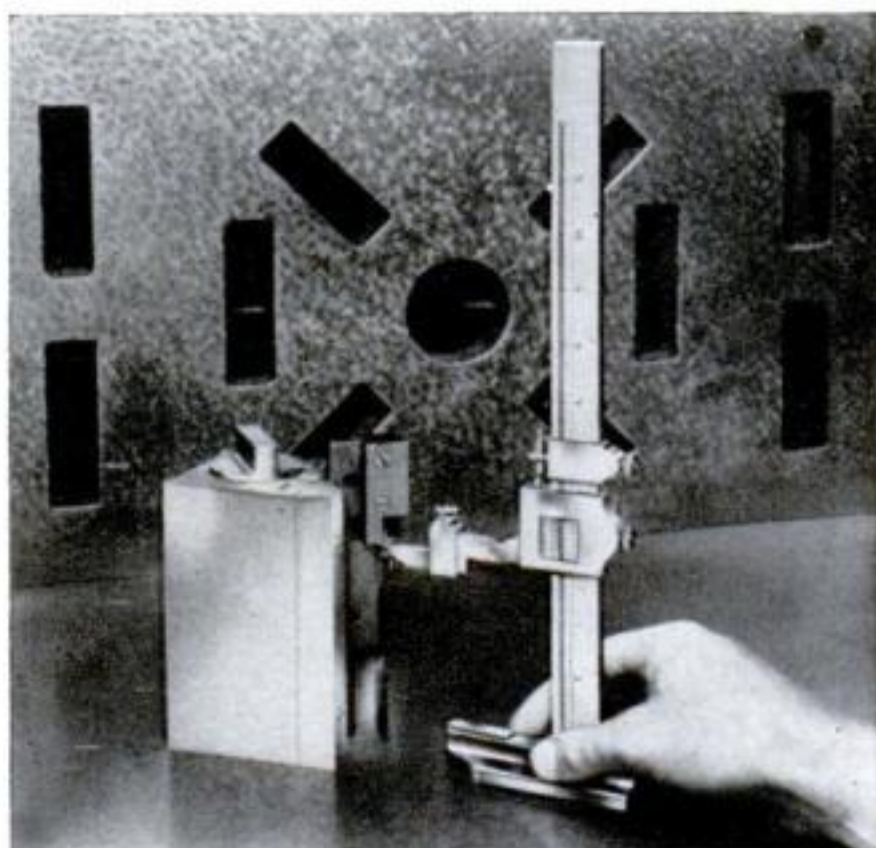


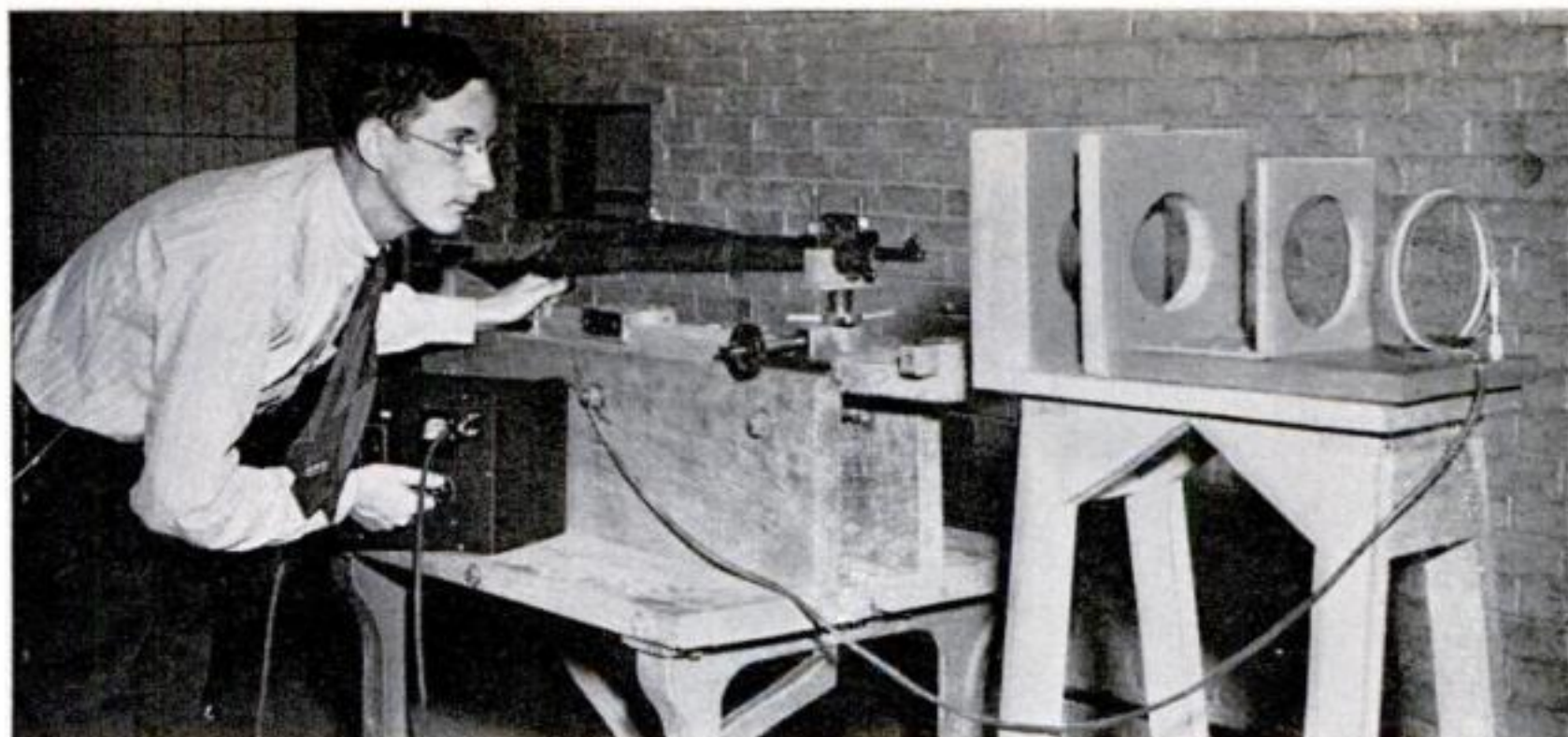
GRINDING DULL OR BROKEN DRILLS accurately in a few seconds' time is easy with a tool recently placed on the market. Fitting all bench grinders and polishing heads, the device handles all drills from $\frac{3}{32}$ " to $\frac{1}{2}$ " in size. It is indexed so that even the most inexperienced workman can grind a proper point on a drill, and its construction is such that the drill can be cooled at any time during the operation without removing it from the holder.



FINISHING OPERATIONS on wood, metal or plastic are simplified with the band sander above. Its table tilts a 45-degree angle for beveling, and bands in any width up to 1" are available. It is designed to run at 1,750 r.p.m. with motors of $\frac{1}{6}$ to $\frac{1}{4}$ horsepower, but step pulleys may be used for higher or lower speeds.

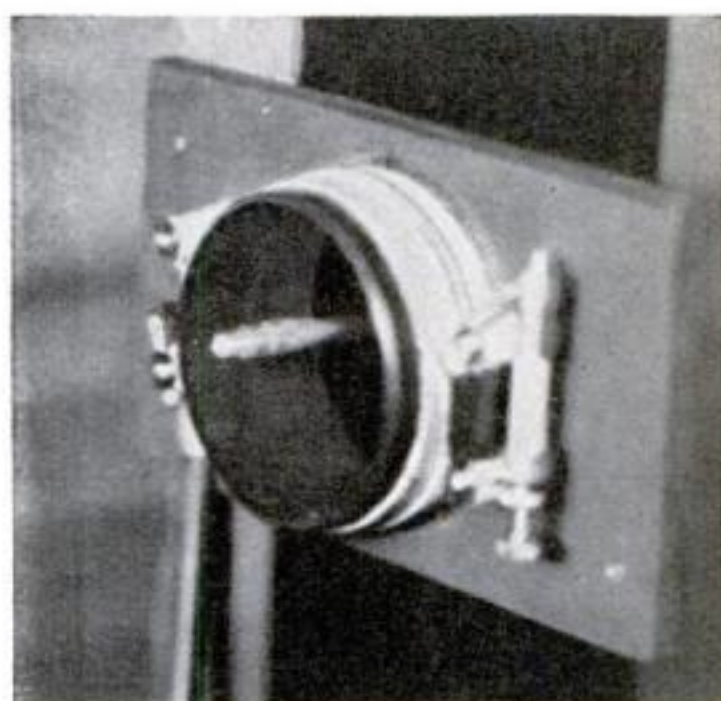
A NEW MAGNETIC TOOL for holding iron or steel work up to $1\frac{3}{4}$ " in diameter is only $2\frac{1}{2}$ " wide, $3\frac{1}{4}$ " high and $6\frac{1}{4}$ " long. Of permanent-magnet type, it has a switch which permits work and tool to be held firmly in place for grinding or other operations, to be partially released for positioning, or to be completely released, depending on the path of the magnetic flux.





Radio Target Clocks Rifle Bullets in Arms Manufacturer's Tests

MEASURING the speed of rifle bullets that are traveling twice as fast as sound is being accomplished in a Bridgeport, Conn., arms laboratory with a radio timing device. The bullet leaves the muzzle of a rifle, traveling about 2,500 feet a second, and passes through two hooplike openings formed of coils with a balanced radio circuit attached to each. As the lead bullet passes successively through these coils, the electrical balance of the circuit is upset. This produces impulses which actuate a delicate timing device called a chronoscope, which records the split-second interval between the passage of the bullet through the first and second coil, making it easy to compute the exact speed of the projectile.



A bullet passing through the first of two coils that gauge its speed. In the upper picture, a research man is firing the rifle

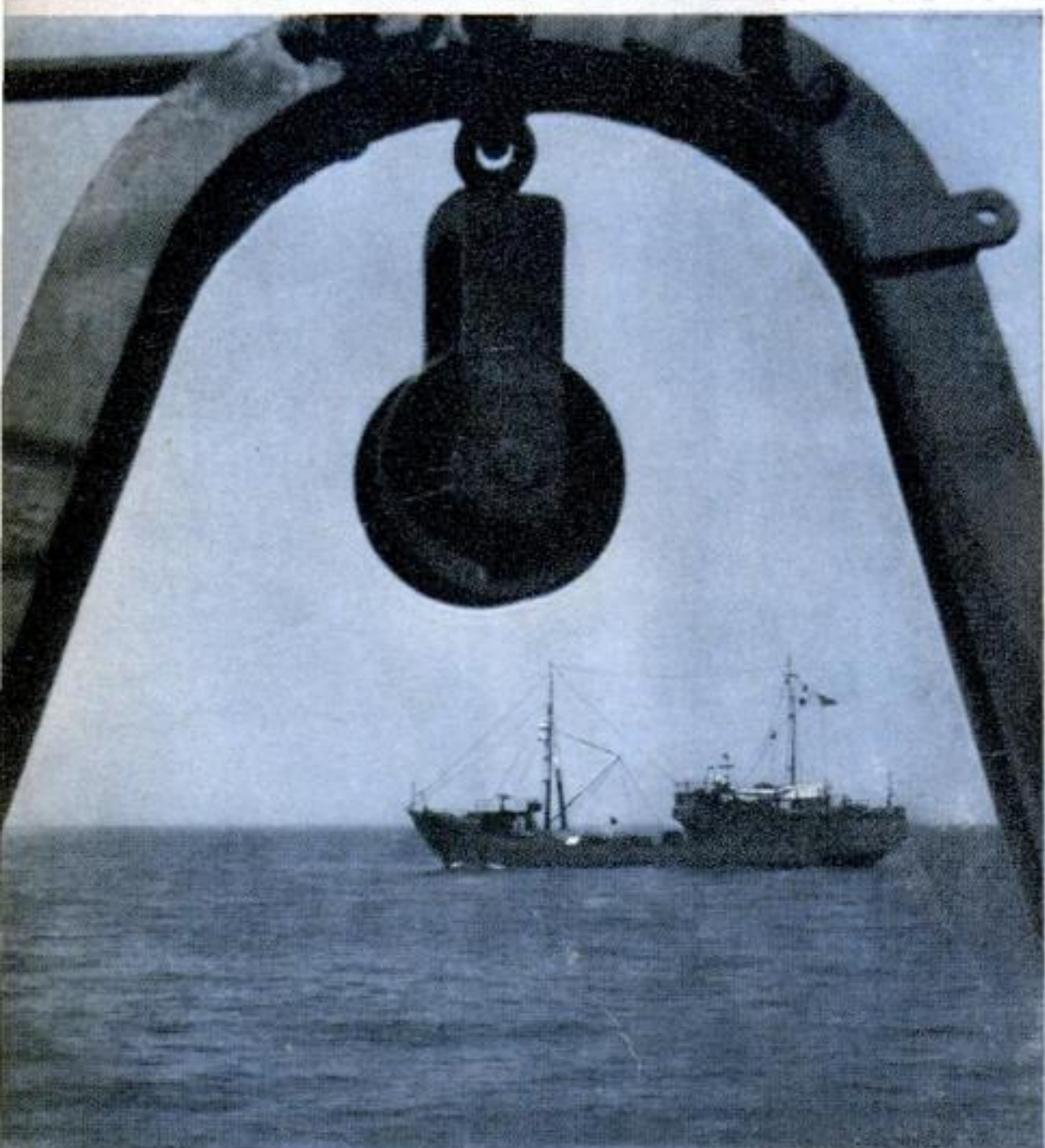


Silent Sound Truck Presents Imitation of Northern Lights

A "SILENT SOUND TRUCK," recently introduced in New York City, gains attention by means of an artificial aurora borealis. A revolving crystal ball, mounted on top of the advertising truck, reflects the light from ten colored spotlights and two specially constructed airport spotlights. Current is supplied to the colored lights, with a total capacity of 100,000 candlepower, by a gasoline-driven generator in the truck. Loudspeakers can be used to supplement the lights.

Fighting the Submarine Mine

HOW NAVIES COMBAT A DEADLY SEA WEAPON



One of the U.S. Navy's coastal mine sweepers, framed in the sweeping gear of another vessel designed for clearing channels of enemy mines of all varieties

By YATES STIRLING, JR.,
Rear Admiral, U.S.N., Retired

ing has as its object to keep enemy ships at a distance from our own coasts and harbors.

The hulls of ships have always been most vulnerable to underwater explosions. It has been found impractical to protect the underwater hulls of ships as is done to the above-water sides, through heavier plating and armor. A mine explosion today that blows a large hole in a ship usually accomplishes its destruction.

Therefore all nations at war are most concerned over the menace of submarine mines to their ships, and consequently they have organized their navies to combat this danger. Every nation has a specialized body of men whose sole duty

is both to combat mines, and to use that weapon for attacks on an enemy.

In the protection of harbors, to prevent enemy warships from entering, there is the observation mine. These mines are moored in channels at some distance below the surface, and are connected up electrically to control stations ashore from which the mines can be exploded, either individually or in groups, when enemy ships arrive in a mined area. Two observers with telescopes from hidden positions ashore converge their instruments upon an enemy ship endeavoring to enter the harbor, and when over a mine the ship can be blown up by the pressure of an electric key. An observation mine is only dangerous to shipping when intentionally used for that purpose.

In the United States, the Army has jur-

THE principle of the submarine mine was invented by Sergeant Bushnell of the American Revolutionary Army over 160 years ago. Bushnell was the inventor of a submarine boat called the *Turtle*, but before he could make this boat a practical weapon of war, he had to prove the possibility of exploding gunpowder under water with destructive effect, which he succeeded in doing. Bushnell therefore was the originator, not only of the torpedo boat, both surface and submerged, but also of the submarine mine.

Mining in war is for the purpose of denying the navigable seas to the ships of an enemy. Its ends are both offensive and defensive. Offensive mining is resorted to for closing the coasts of an enemy and his harbors to the passage of ships. Defensive min-



Members of a sweeper's crew laying out a cable rig designed for destroying mines. The cables are stored on big motor-driven reels. These photographs were made during practice work by the mine sweepers Catbird and Curlew

isdiction over mine planting for harbor-defense purposes, and maintains vessels specially designed to lay them and to guard them.

The Navy has a separate mine service, mostly concerned with mines of the contact varieties. It lays the mine fields for defense purposes off our coast, and also is responsible for the sweeping up of mines laid by the enemy that menace navigation. The Navy also mines offensively, laying mines off the enemy's coast in order to restrict the

Fooled with live mines is dangerous business, and members of sweeper crews wear life belts which can be inflated instantly with carbon dioxide gas . . .

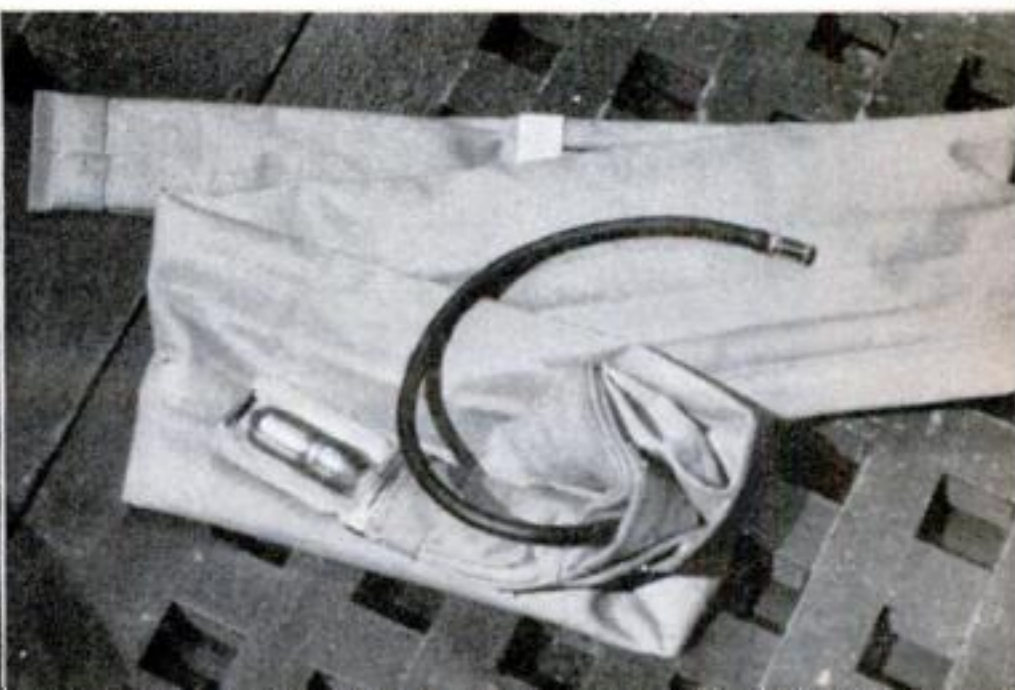


Sweepers working in line must keep the proper distance apart. Here an officer aims a range finder at a companion ship

Like a lashing tail, the sweeping gear streams out in the wake of the vessel. In sweeping for the moored type of mine, the gear goes out from a boom at the side of the ship to a float or to an accompanying vessel

movements of his ships. There are several types of contact mines, and each explodes automatically when a ship strikes it. In general terms, a contact mine consists of a mine case containing the explosive, and a self-acting anchor and cable. This combination is dropped over the side or at the stern of a mine-laying vessel. The mechanism of the mine and the self-acting anchor and cable automatically determine the depth that the mine will float beneath the surface,

... if an explosion near by washes a man overboard. The gas is released from a small bottle. The rubber tube is used to blow air in to open up the belt



no matter what the depth of water may be.

Contact mines are used defensively to restrict the movements of enemy ships in our home waters. As a contact mine is as dangerous to friend as to foe, a defensive mine area must be most carefully charted, leaving secret passages known to friendly pilots, through which our own and neutral ships can pass in safety to enter our ports.

Offensive mining by the Navy on the enemy's coast need not be so carefully charted, but even then it is well to know where mines are laid for the benefit of our own warships.

Horned mines, antenna mines, magnetic mines, the unmoored Leon mines, and the acoustic mines illustrate the diversity of present-day types of contact mines. Mines contain anywhere from 300 to 500 pounds of T.N.T., and against the bottom of a ship their explosion is always most destructive.

The horned mine has leaden fingers on the outside of its globular or pear-shaped face. These fingers serve as triggers. When a ship strikes a finger the force of the impact breaks a glass vial within the mine case, spilling a chemical solution into a cup with zinc and carbon strips, or electrodes, thus producing an electric battery which energizes the firing mechanism and explodes the mine.

The antenna mine, introduced by our Navy during World War I, gives a wider danger field than the horned mine. It is not necessary that this mine be actually struck by the hull of a ship. Above it there is a float supporting a long vertical copper wire, and when the steel hull of a submarine or surface vessel touches the copper wire, the galvanic action of the dissimilar metals causes a weak current of electricity to flow in the mine, and this current operates a relay to energize a supersensitive electric firing device that detonates the mine.

This type of mine, with its greatly increased danger zone, was used in the North Sea Barrage laid in 1918 by the Yankee Mining Squadron under Captain Reginald Belknap, which closed in the German submarines within their bases with a mine field stretching across the North Sea and containing 70,000 mines. In the present war, Great Britain has used an adaptation of this mine in laying a defensive belt of about 200,000 mines eight miles off shore along the entire east coast of Great Britain.

The magnetic mine is exploded when a steel vessel passes over it or near it. Its principle is that of the magnetic needle,

which is deflected when it comes under the influence of a magnetic field such as is produced by the hull of a steel vessel, and explodes the mine.

The Leon mine, a Swedish invention, has no mooring cable and maintains its depth under water by means of an electric-powered propeller, run by a storage battery. It has a limited duration, and becomes inoperative when its storage battery is exhausted.

Acoustic mines are actuated and fired by the sound of a passing vessel. This type may some day become most dangerous as the acoustic principle is further explored by scientists. There is an American invention by which an acoustic torpedo is fired at a ship, and when it comes within range of the noise of the ship's propellers, it will follow the sound to a hit.

Now that we have explored the several types of mines, what are the means that have been devised to overcome the menace?

The observation mine used by our Army can only be rendered harmless by reducing a fortified harbor by gunfire and bombing planes, thus obtaining control of the electric circuit that fires the mines.

Contact mines of the finger type and the antenna type can be swept up by mine sweepers. This is a dangerous operation, and many of these plucky little vessels have been blown up in performing it.

The U. S. Navy has a number of mine sweepers already in service, and is building more modern ones, equipped with all the new devices that experience has shown to be necessary. That there are not enough of these vessels is evident from the fact that scores of trawlers have been recently purchased for conversion into mine sweepers. Some of the older destroyers have been equipped with sweeping gear. The high speed of the destroyers enables them to clear mines from a large area ahead of a naval attacking force in a minimum of time.

The Navy's coastal mine sweepers are vessels similar in design and appearance to powerful tugs, and are fitted with gear to locate moored mines, and cutting gear to sever the mines from their anchor cables when located, permitting them to float to the surface where they can be exploded by machine-gun fire.

This sweeping gear consists of a heavy wire cable, about 150 fathoms in length. The cable is streamed out from the side of the sweeper. On the cable is a "depressor," located about 30 feet along the cable. This

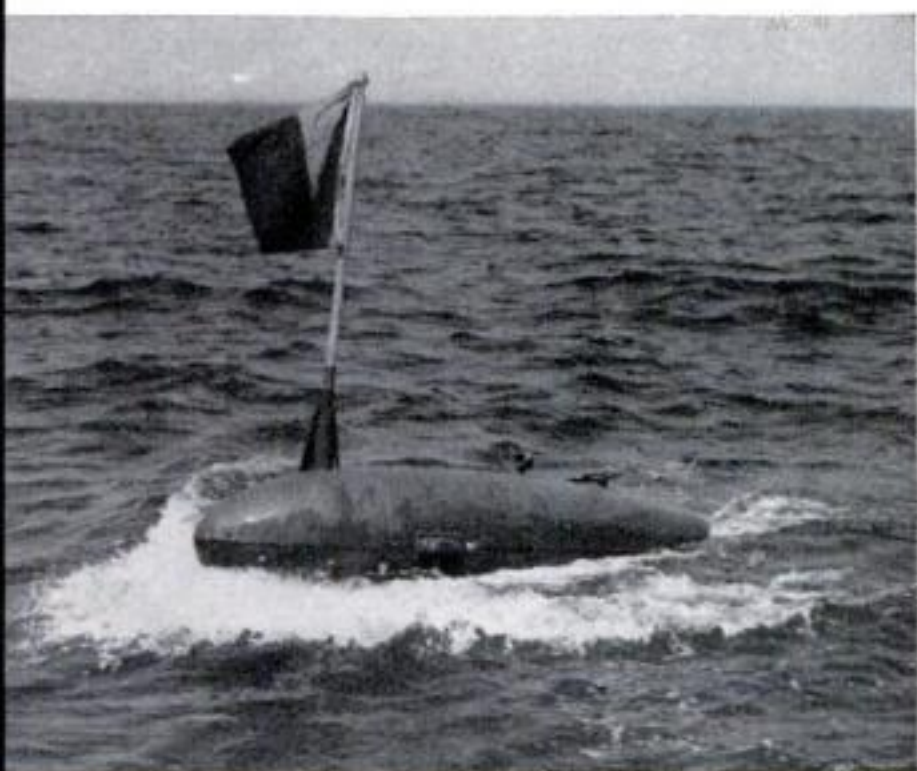




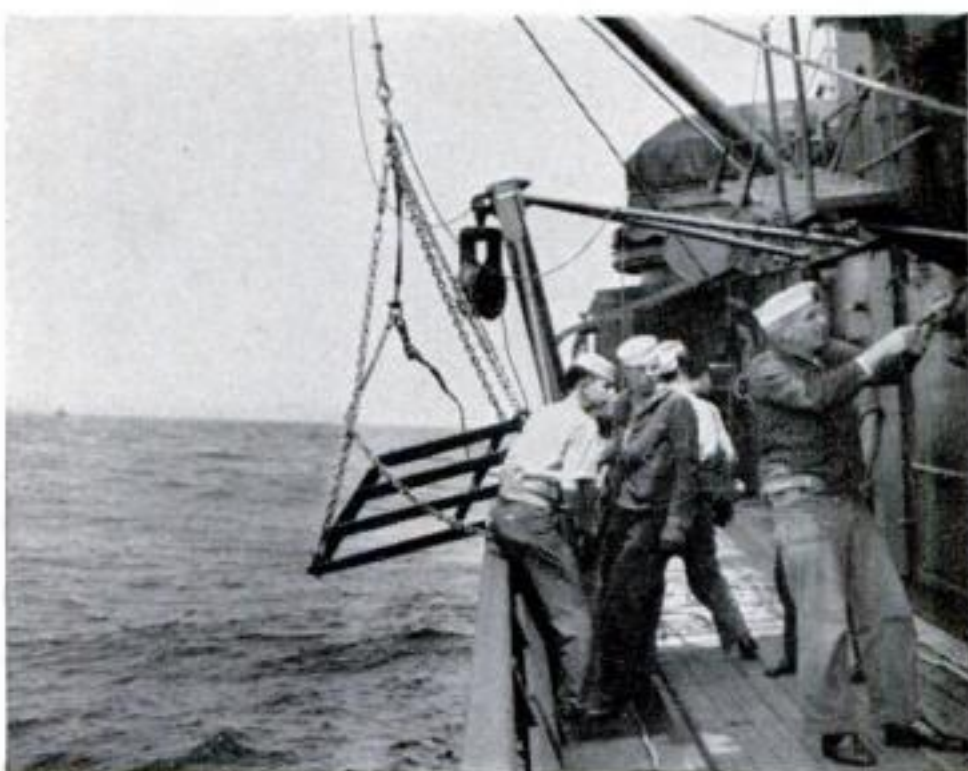
The otter, a metal underwater kite, is part of the gear used in sweeping moored mines, as illustrated in the drawing at the bottom of page



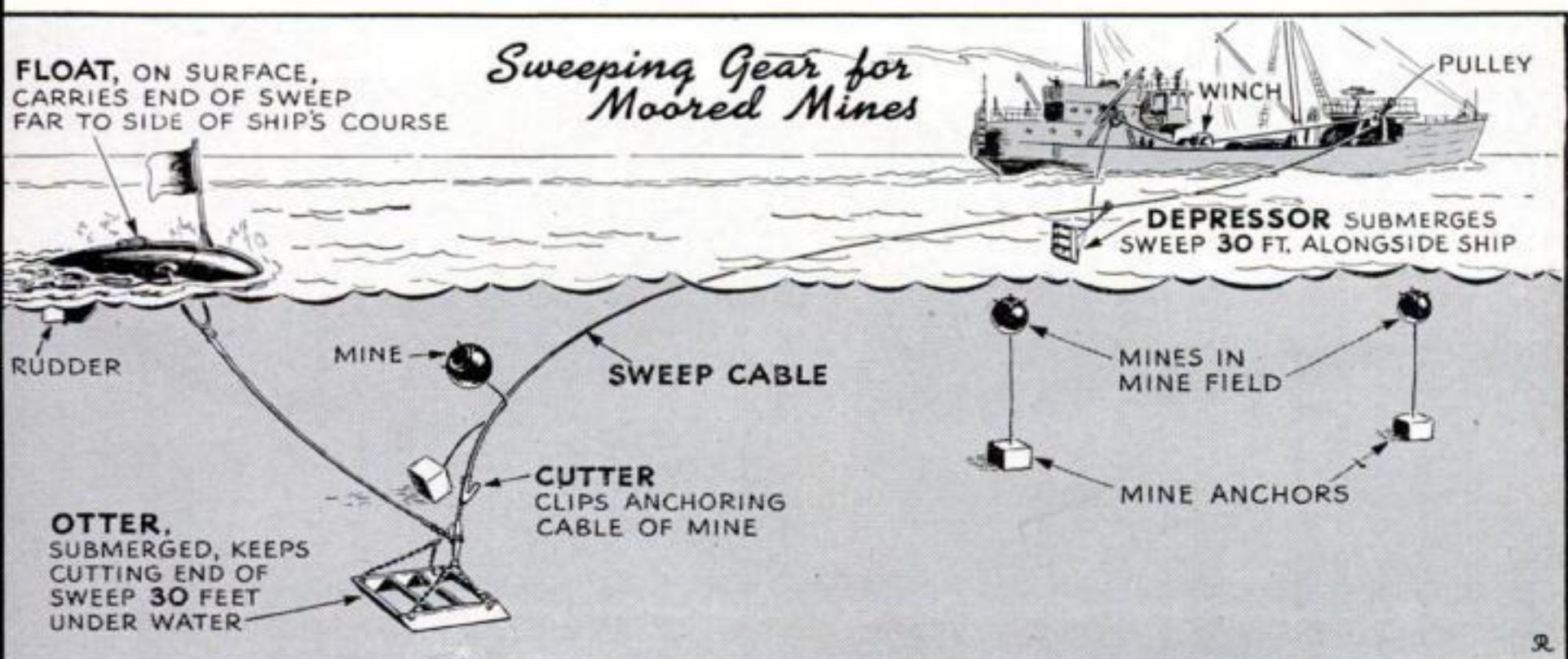
When not in use, the float rests in a cradle on the sweeper's deck. Its purpose is to support the end of the drag cable out from the ship

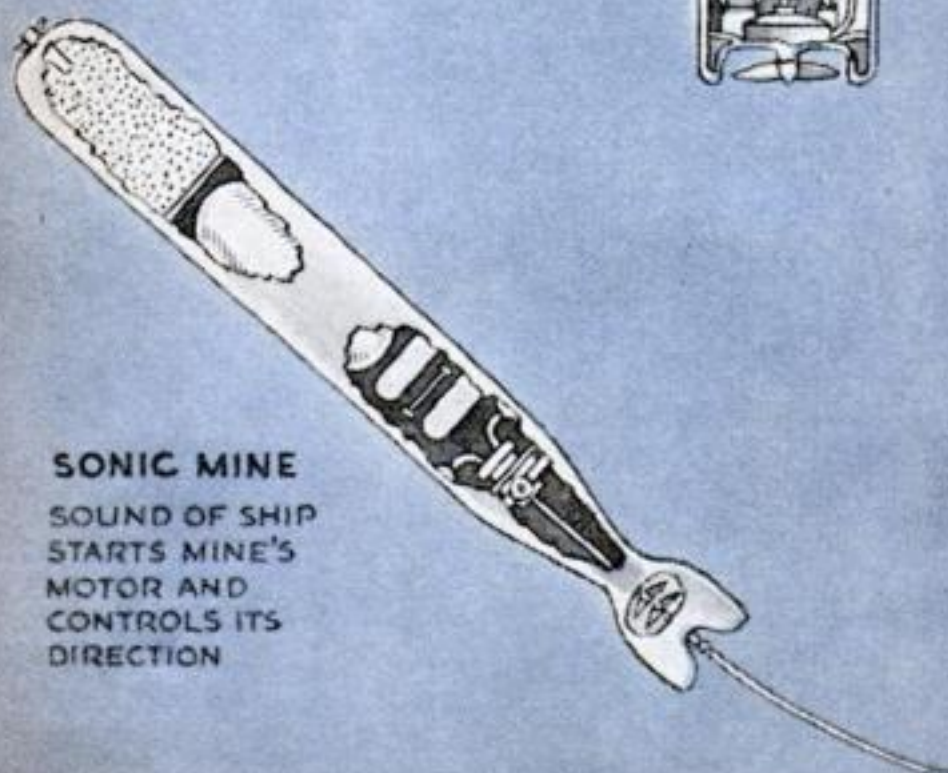
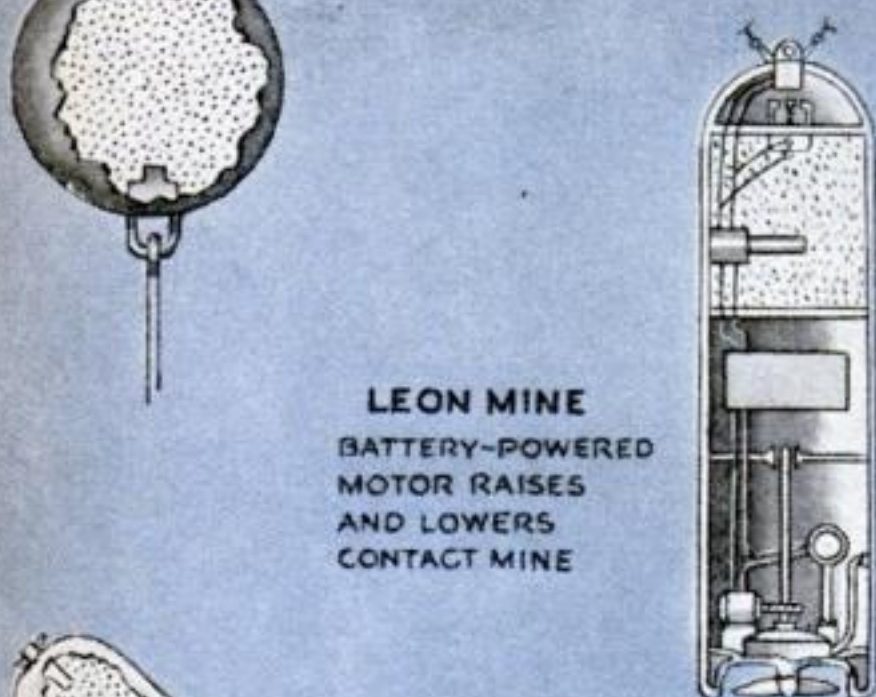
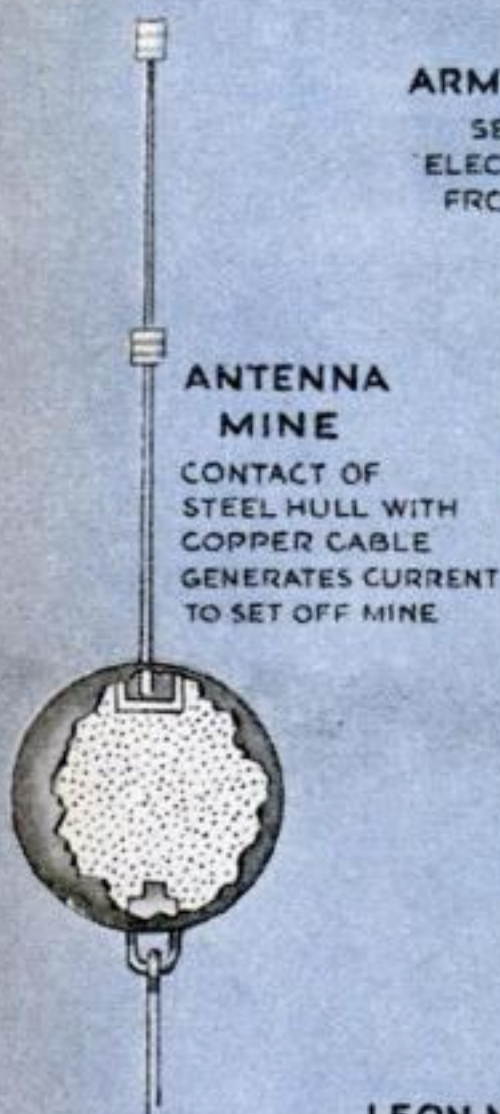
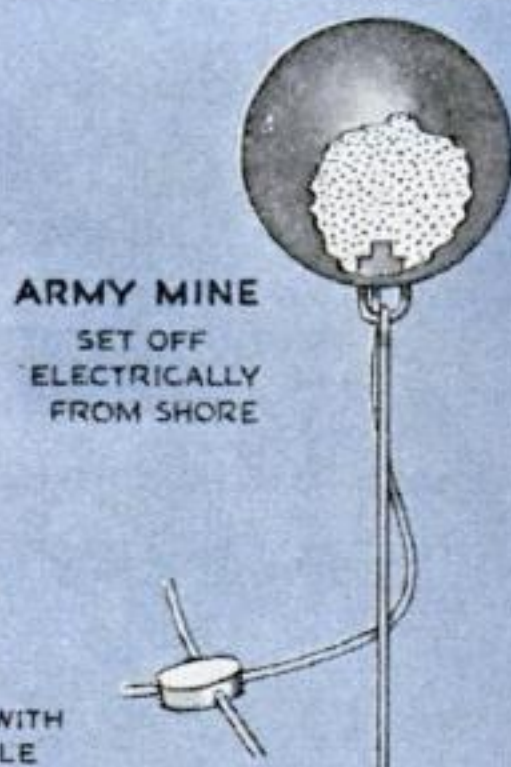
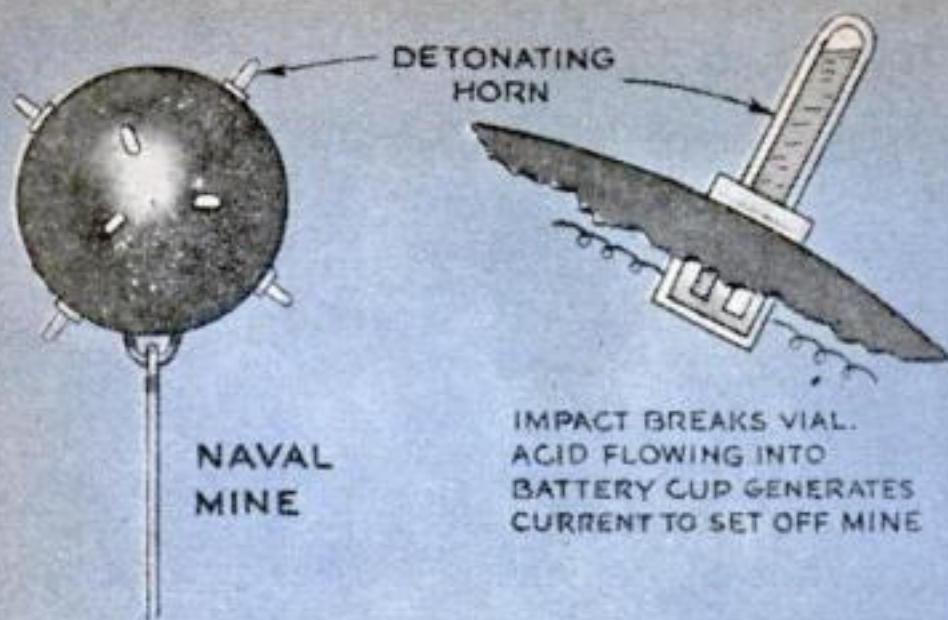


In the water, a fixed rudder keeps the float tugging away from the sweeper, holding the drag cable at tension. The flag marks the sweep's end



To keep the cable at the proper depth for snaring mine moorings, a depressor is rigged on the line. Here it is going over the sweeper's side





keeps the cable buried under water. On the end of the cable is the large float, and at about 30 feet inside the float on the cable is what is called an "otter," or water vane, that keeps the cable buried, and then there is the cutter, a sawtooth instrument that severs the mine from its anchor.

The sweeper steams along with this cable and float streaming out from its quarter. The anchor cable of a mine, between the mine and anchor, will catch on the sweep cable and then travel along the cable until it reaches the cutter when the mine is cut loose and floats to the surface.

Mine sweeping can be accomplished by single vessels or with groups of vessels, depending upon the extent of the channels to be swept. In sweeping a channel for a fleet to pass in safety, no less than four sweepers would operate at once. The usual formation of the sweepers is an echelon, so that a sweeper will protect the one astern of it, and thus only the leader is in danger of striking a mine. There are many formations that can be taken by the sweepers. They can be in pairs, steaming parallel to each other, with sweep wires on the outboard sides of both vessels, and an additional sweep wire between them. These pairs of sweepers can also operate with others in echelon astern of them. In this way a wide channel can be swept.

The magnetic mine was first laid by Ger-

Five main types of mines used by the navies and armies of the world are illustrated in the drawing at the left. Below, how sweepers would clear a channel for a fleet to pass through an enemy mine field. While many formations are possible, they usually operate in echelon, with the sweep of each vessel protecting the ship behind it. In this way, only the leader is in danger of striking a mine. Planes help by locating mine fields from the air





many, and frequently dropped from airplanes to land inside harbors or in channels that are constantly used by the ships of its enemy. Some of these German mines dropped from airplanes were attached to parachutes to make accurate laying possible.

THE WAR in Europe, because of the geographical positions of the two great adversaries, has expanded the use of mining enormously. Each nation has aimed to hem in the other's warships, and to make the routes taken by merchant shipping in narrow waters most dangerous. Each has laid both offensive and defensive mine fields in great numbers, so that it has become necessary for the two nations to be constantly employing a large number of vessels, both to lay mines and to sweep them up. The North Sea, the Baltic, and the English Channel are thickly strewn with mines laid by both Germany and Great Britain. The greatest vigilance is required to protect vessels from the menace of this weapon, for a nation's commerce and the movement of its warships are dependent for their security upon the effectiveness of its mine-sweeping services.

The episode of the German submarine entering Scapa Flow and torpedoing a British battleship is convincing evidence that anti-submarine net tenders are needed in all of our important harbors. Without nets and net-tender vessels a submarine might enter New York Harbor at night and lay mines in the channel even as far as the Narrows.

Operations like those of the mine sweepers *Catbird* and *Curlew* shown in the photographs, in the New York area, are for the purpose of clearing channels of mines of all types, including magnetic mines, either laid by surface ships, submarines, or airplanes.

Ships performing this work have special protective devices making operations reasonably safe for the personnel, though not entirely so. Life belts which can be inflated with carbon dioxide gas are worn by all on board, since a geyser of water from an exploding mine too close aboard may wash men overboard.

Individual ships can be protected from the contact mine by the use of paravanes. The paravane is a sort of torpedo-shaped scooter which hangs from a yardarm stretching out from the side of the vessel. In the head of the paravane is a large steel plane, and near its tail there are horizontal and vertical fins. The plane is set at a small angle to the center line of the paravane so that it is in an approximately vertical position when the paravane is being towed through the water. The thrust of the water on the plane when the vessel is in motion carries the paravane away from the fore-

and-aft line of the ship. The mine anchor wire is caught on the cable towing the paravane, and the mine is thus carried away from the ship's side until it reaches the jaws of the cutter located on the paravane. Similar paravanes are used by mine sweepers.

One means of establishing the position of hostile mine fields is by photographing a suspected area from an airplane patrol. From a height of several thousand feet, mines can be seen against a sand or a light-colored bottom, and can readily be photographed.

One of the most difficult mines to deal with is the delayed-action mine. This does not become armed until some substance within the mine dissolves and makes operative the electric circuit, thus arming the mine and making it ready to be exploded when a ship strikes it or passes near it.

The British have devised a means of demagnetizing a ship to make it immune from a magnetic mine, but it has not been entirely successful when used in battleships.

For the laying of mines, several types of vessels are used. There is the mine layer, a warship of from 1,000 to 6,000 or more tons displacement, of high speed, and capable of carrying, depending upon size, from 80 to as many as several thousand mines. It usually operates at night alone, or in the daytime protected by an escort of fighting ships, and is used when a mine field of considerable size is to be laid. The mine layer *Terror* and two others are under construction for our Navy, the first to be built for that purpose. Usually commercial ships and destroyers are converted into mine layers.

GERMANY developed during World War I a very efficient submarine mine layer, and has this type in numbers in its Navy today. The mines are carried in wells at bow and stern of the vessel, and in the bulges at the side, or are ejected horizontally through tubes at the submarine's stern. The United States built a very large submarine mine layer, the *Argonaut*, of 2,700 tons surface displacement, armed with two six-inch guns and carrying 60 mines.

The submarine as a mine layer is most effective and useful. It can reach a position for laying mines on the enemy's coast alone and unescorted. It can lay mines in the actual presence of surface warships on patrol without detection. Mining from a submarine is more often performed at night.

During World War I German submarine mine layers traveled all the way to the American coast to lay mine fields off New York Harbor, off Delaware and Chesapeake Bays, and off Cape Hatteras, on the coastal ship lanes. Several ships were destroyed by the mines before they were discovered and swept up.



A model of the head of a poisonous snake showing its fangs, poison sacs, and other parts, one of the more than 100,000 items carried in stock by Ward's Natural Science Establishment, Rochester, N.Y., for sale to museums and private collectors

Below, models of frog eggs are being made. They will be used in an educational display that shows every stage of development from the beginning of the egg until the tadpole appears



MUSEUMS FOR SALE

Anything from an Embalmed Tomcat to a Dinosaur Track

MAIL TIME at Ward's Natural Science Establishment, in Rochester, N. Y., puts the game of grab-bag on a scientific basis. Nobody can guess what will come out of the mail pouch next. It may be a meteorite in a cigar box. It may be butterflies wrapped up in the classroom papers of a mission school in Peru. It may be an order for a dinosaur track, an embalmed tomcat, 200 clothes moths, a dozen live bullfrogs, or a 50,000,000-year-old fly embedded in amber. At no other place on earth could you fill the shopping list which Ward's, almost daily, is accustomed to take in its stride.

This unique institution, now celebrating

its 80th year, has supplied exhibits to virtually every museum in America. In fact, it has helped start most of them. And such celebrated natural scientists as Frederic A. Lucas, first director of the American Museum of Natural History, in New York City; Carl Akeley, famous African explorer; William Morton Wheeler, Harvard entomologist; W. T. Hornaday, first head of the Bronx Zoo; and E. E. Howell, former chief of the U. S. Geological Survey, have served their apprenticeship at Ward's.

Among the more than 100,000 items carried in stock, you encounter fossil worm burrows, extinct passenger pigeons, meteorites containing gold, prehistoric fish that

resembles beetles, shark teeth, uncut diamonds, fluorescent snail shells, even the circulation system of a pig—without the pig. Including a sub-basement, known as The Black Hole of Calcutta, and a mineral storage shed, called The Rock Pile, the Rochester supply house has more than 50,000 square feet of floor space. A recently installed loudspeaker system saves steps for the workers.

Henry A. Ward, who founded the establishment shortly after the start of the Civil War, was an upstate New York farm boy who became interested in museums while working his way through Williams College. When Louis Agassiz, the celebrated Harvard naturalist, lectured in a town 28 miles from the college, young Ward, unable to spare the carfare, walked all the way. He arrived when the lecture was half over but afterwards met Agassiz and later became his assistant at Harvard. Continuing his education in Paris, Ward supported himself by buying and selling fossils. At the age of 27, he returned to America, bringing with him the finest natural-history collection in the country. After teaching for a year at the University of Rochester, he started his museum supply house in 1862.

In the years that followed, he traveled around the world 15 times, collecting material. Once he bought a whale in Australia and shipped it to Rochester, later selling the skeleton to the Smithsonian Institution, in Washington, D. C. When John James Audubon died, Ward bought his collection of mounted birds and when Jumbo, P. T. Barnum's famous elephant, was killed, the carcass was shipped to Rochester for mounting. The next year, Ward offered Jumbo's heart—weighing 46 pounds—for sale for \$40.

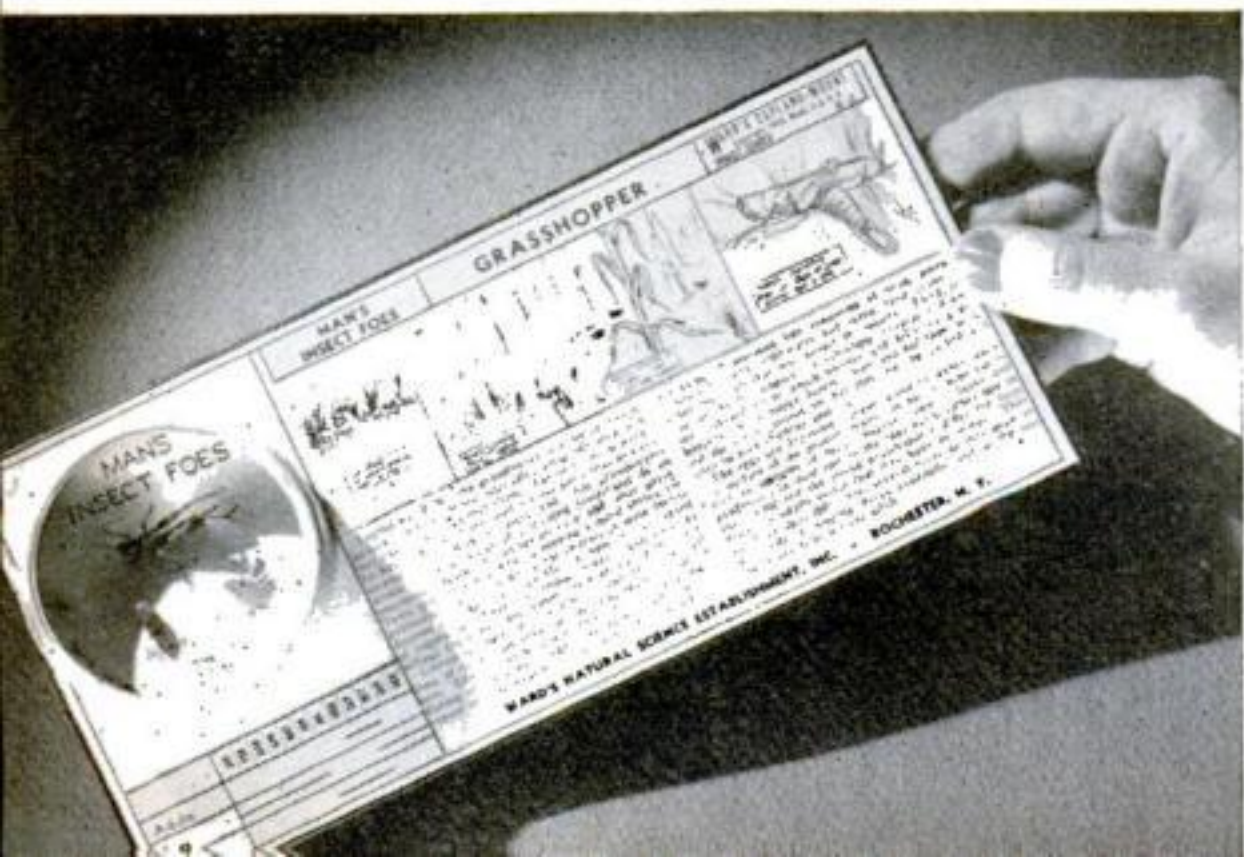
The biggest single sale ever made came to a little over \$100,000. At the time of the World's Columbian Exposition, in Chicago in 1893, Ward was asked to assemble a vast amount of natural-history material under the arrangement that it would be purchased by the City of Chicago when the fair closed. At the end of the exposition, the city was unable to carry out its bargain. Ward was facing bankruptcy when the Chicago department-store owner, Marshall Field, bought the material and started the now-famous Field Museum.

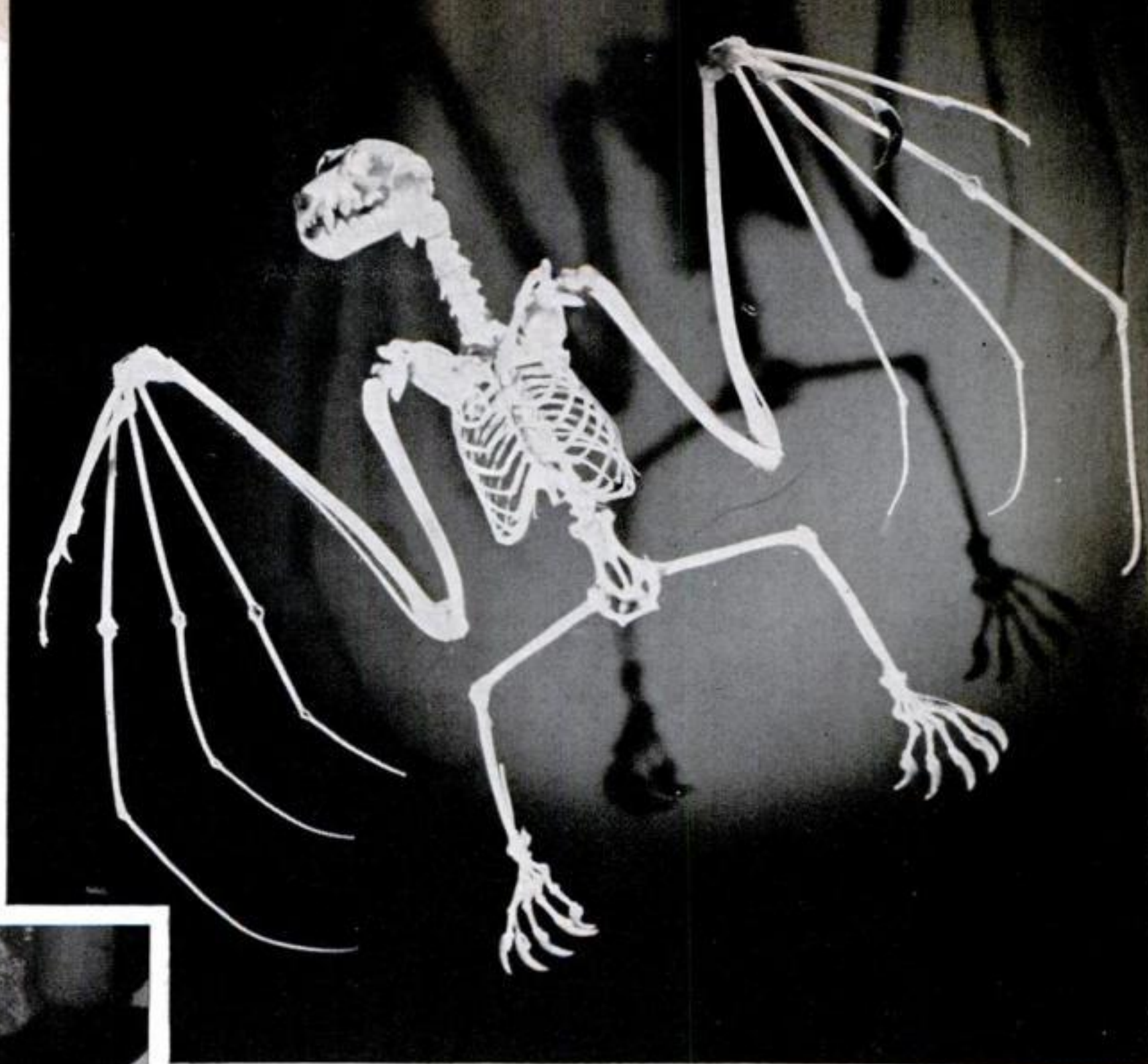
More than 3,000 correspondents all over the world send in material to the Rochester supply house. Missionaries, mining engineers, explorers keep on the lookout for rare items. Hardly



Rare insects come to Ward's from missionaries, explorers, and other correspondents all over the world. Here the head of the entomology department is preparing some specimens for sale

"Explano-Mounts" for studying insect life combine text with actual specimens of the subject in various life-history stages





Bats' skeletons are for sale at Ward's, as also are gold-bearing meteorites, a fossil worm burrow, and a plastic model of the circulatory system of a pig. At the left, a worker is busy assembling bullfrog skeletons

a week passes without some returning traveler arriving at Ward's with a collection of oddities. It may be a prospector from Mexico in a dilapidated car loaded with mineral specimens or a man from Australia peddling opals or a missionary with skins of the giant pangolin.

Not all purchases are made by collectors and museums. Each year, the sales total is swelled by a considerable sprinkling of oddity requests.

In Florida a woman ordered 20 of the largest sea shells known, 600-pound monsters from the South Seas. She wanted to use them as part of an elaborate outdoor fountain. In Ohio, an advertising concern

purchased several hundred clothes moths to put in the transparent heads of pencils as an advertising stunt for an exterminating company. Prehistoric fish, 60,000,000 years old, have been purchased for the wall decorations of sporting lodges, and dinosaur tracks in stone have been used in fireplaces and garden walks. An amateur photographer in Minnesota buys grasshoppers and other insects for use in table-top photography.

A Cuban who had failed several times in business once ordered the head of a white weasel which he believed would bring him success in all his ventures. Since then, Ward's always has one of them in stock.

In spite of the fact that it is four score years old and the only institution of its kind in existence, Ward's is far from leaning back on its oars. Innovations are constantly tried out. The latest is the use of synthetic resin for injecting into the veins of killed animals to preserve the circulation systems for classroom study and museum display. After the death of the founder in 1906, the unique institution was operated by the heirs. Recently it was donated to the University of Rochester and is now administered by University authorities as a memorial to Henry A. Ward.

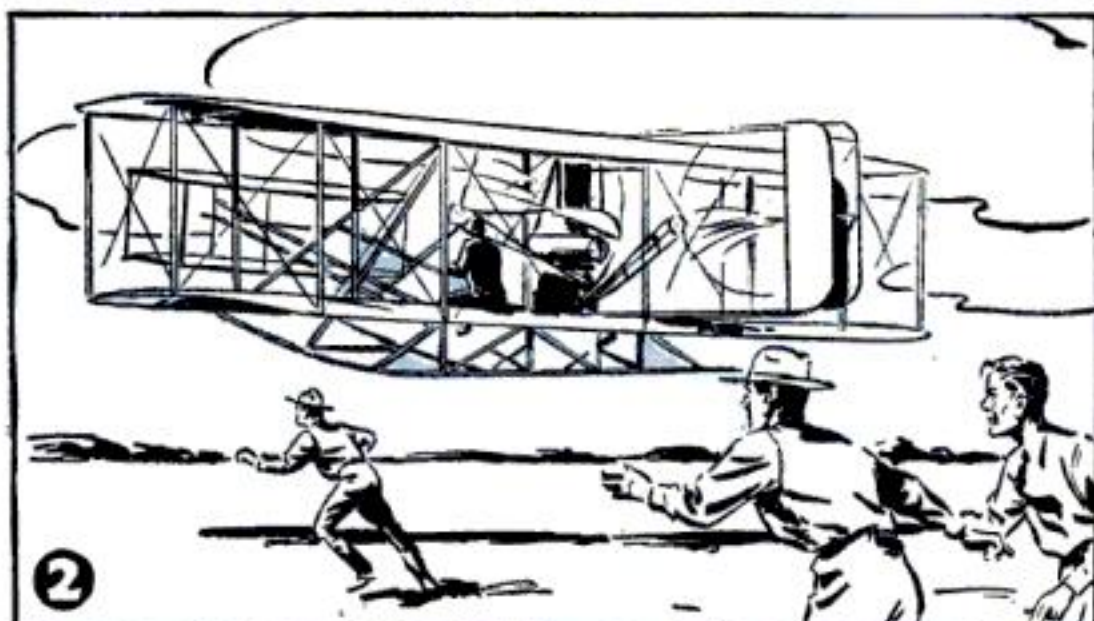


Here's My Story

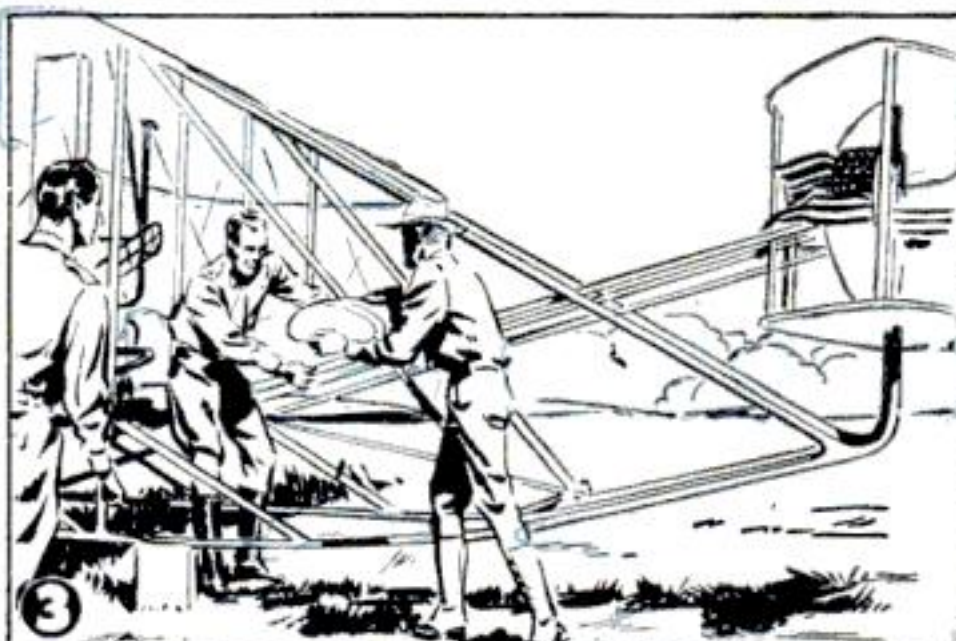
GENERAL ARNOLD IS CHIEF OF THE ARMY AIR FORCES AND DEPUTY CHIEF OF STAFF FOR AIR



1 A NATIVE OF GLADWYNE, PA., GENERAL ARNOLD WAS GRADUATED, AT 21 FROM WEST POINT IN 1907, AND COMMISSIONED A SECOND LIEUTENANT IN THE INFANTRY



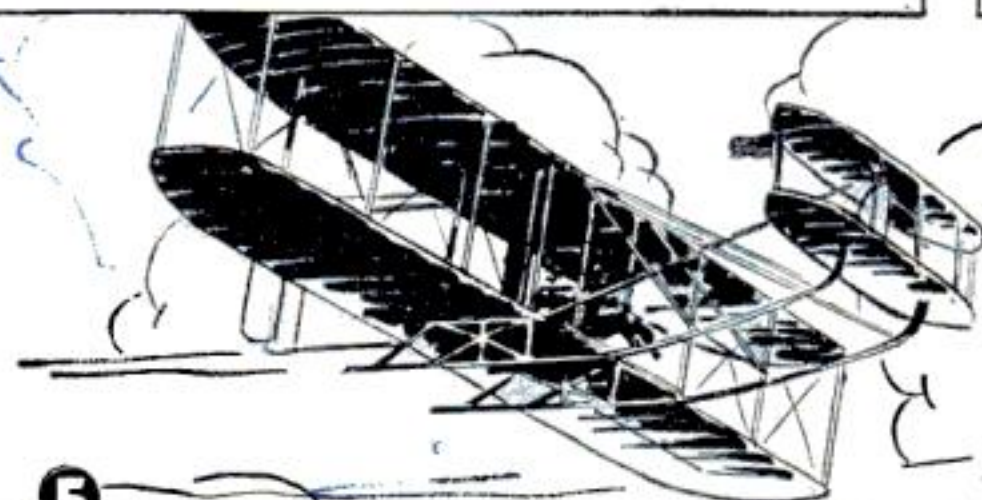
2 IN 1911 HE LEARNED TO FLY AT THE WRIGHT BROTHERS FLYING SCHOOL AT DAYTON, OHIO. AT THAT TIME THE ARMY'S AIR FORCE CONSISTED OF ONE PLANE AND A HANDFUL OF MEN



3 DURING HIS FIRST YEAR HE MADE 140 FLIGHTS, TOTALING 29 HOURS, QUITE A RECORD FOR THOSE DAYS. HE ALSO FLEW THE FIRST AIR MAIL IN THAT YEAR



4 ABOUT THE SAME TIME HE ESTABLISHED WHAT WAS THEN A WORLD'S ALTITUDE RECORD BY FLYING A BURGESS-WRIGHT PLANE TO A HEIGHT OF 6,540 FEET



5

IN 1912 HE WON THE MACKAY TROPHY BY MAKING A RECONNAISSANCE FLIGHT IN WEATHER SO BAD THAT ONLY TWO OUT OF 12 PILOTS COMPETING FOR THE TROPHY WERE ABLE TO TAKE OFF. HE FLEW OVER THE CAPITOL DOME ON A BLUSTERING FALL DAY IN BELOW-FREEZING TEMPERATURE

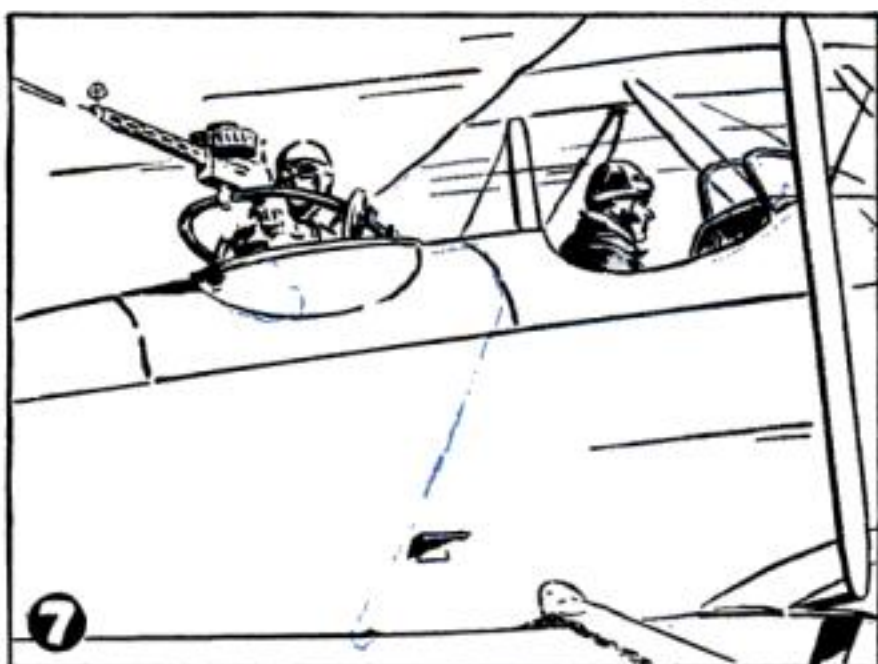


THE CAREER OF MAJ. GEN. H. H. ARNOLD



6

HE USED A RADIO IN A PLANE AT FORT RILEY, KAN., TO DIRECT ARTILLERY FIRE FROM THE AIR, THUS BECOMING THE FIRST AVIATOR TO USE THIS FORM OF COMMUNICATION FROM AIR TO GROUND



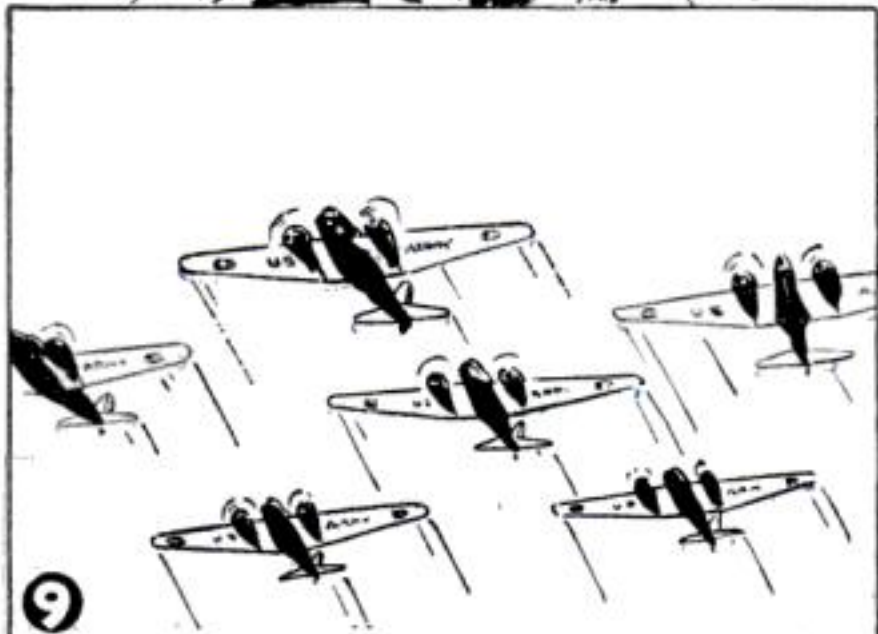
7

HE WAS ALSO ONE OF THE FIRST PILOTS TO EXPERIMENT WITH MACHINE GUNS MOUNTED IN PLANES



8

WHEN THE U.S. ENTERED THE WAR IN 1917, HE WAS PLACED IN COMMAND OF THE 7TH AERO SQUADRON, WHICH HE HAD ORGANIZED, AT THE PANAMA CANAL



9

IN 1934 HE COMMANDED TEN ARMY MARTIN BOMBERS ON A FLIGHT FROM WASHINGTON, D.C., TO FAIRBANKS, ALASKA, AND BACK. FOR THIS HE WAS AWARDED THE MACKAY TROPHY A SECOND TIME



10

PROMOTED TO THE RANK OF MAJOR GENERAL IN 1938, ARNOLD WAS APPOINTED CHIEF OF THE ARMY AIR CORPS. HE WAS PROMOTED TO THE GENERAL STAFF AND ASSUMED HIS PRESENT DUTIES THIS YEAR

Portable Kit Gives Blood Transfusions on the Battlefield



Kit being set up for emergency blood transfusion. Sealed in the cans in foreground is dried plasma

BLOOD TRANSFUSIONS can be given to accident victims or wounded soldiers almost anywhere with an emergency kit that can be set up for use in one minute. Weighing only 12 pounds, the kit contains dried blood plasma, packed in rubber-stoppered bottles which are sealed in eight-by-three-

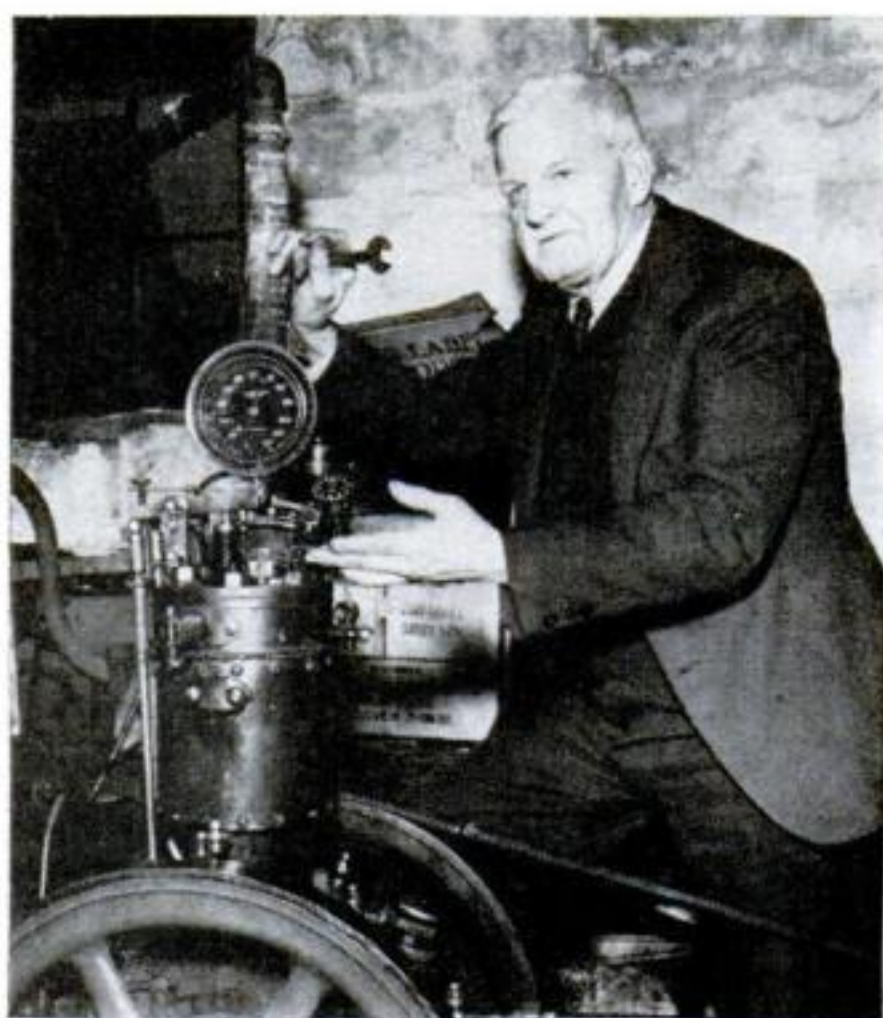


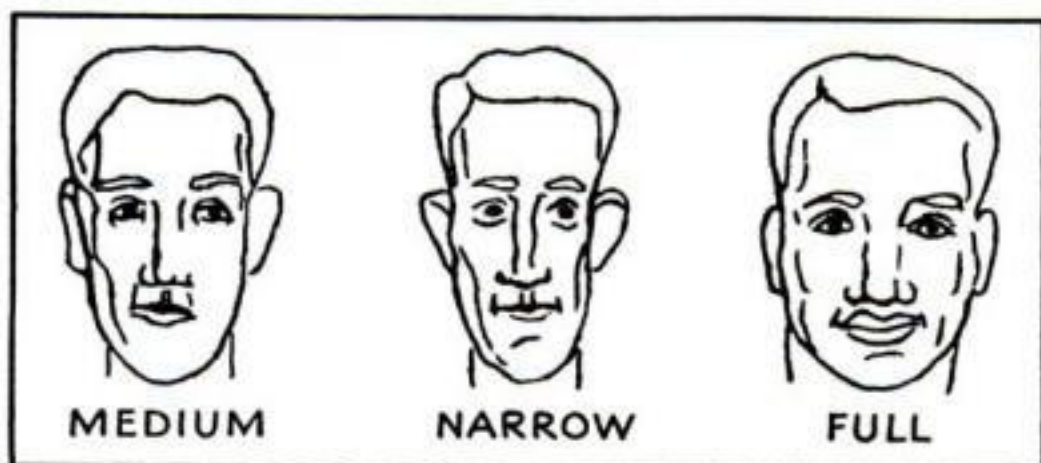
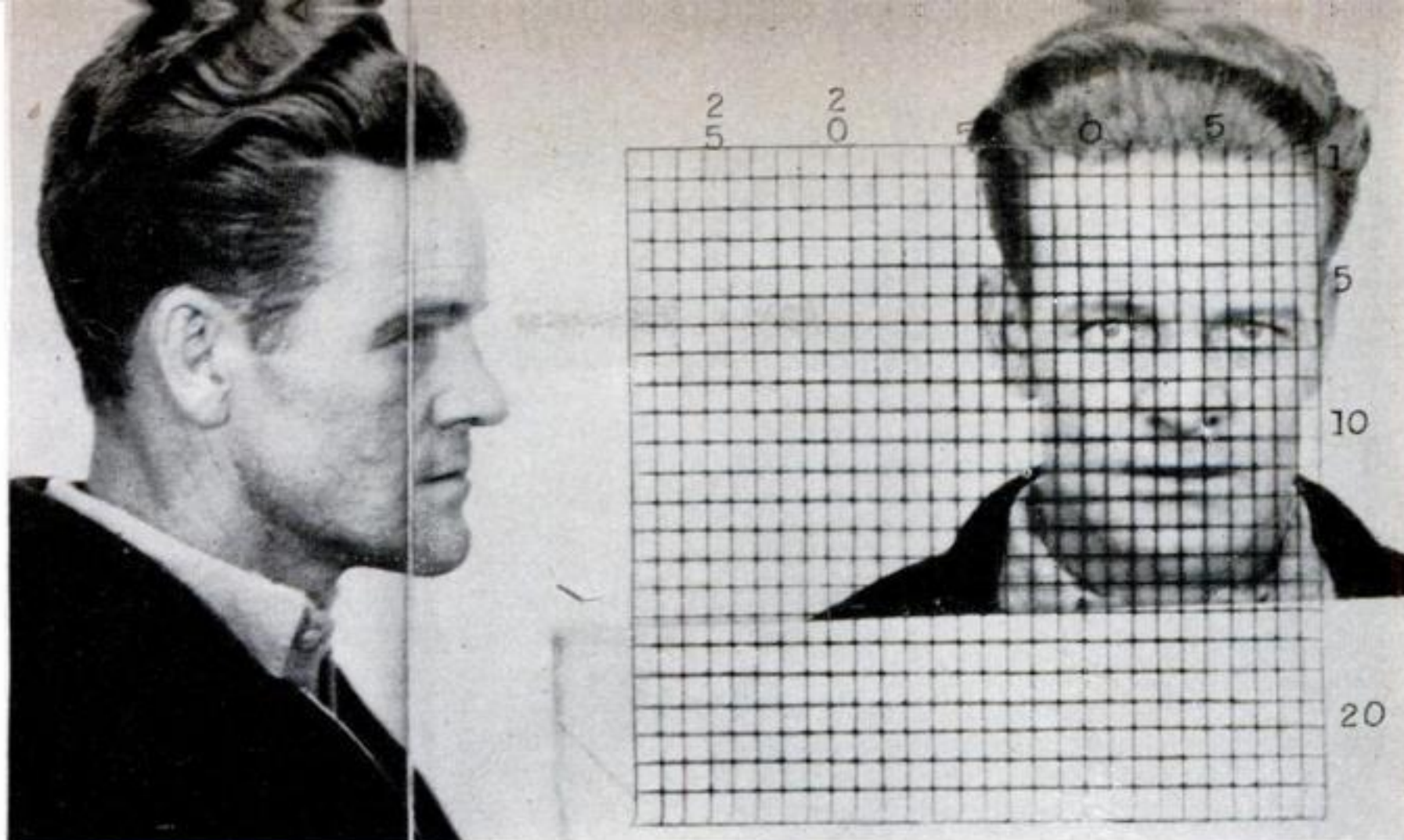
In operation at scene of an accident. Blood kit is ready and transfusion is given where minutes count

inch cans; a bottle of sterile water to mix with the plasma; rubber tubing and a needle for injecting the solution into the veins of the patient, and other necessary equipment. The kit holds enough water and plasma to make a solution equivalent to 500 centimeters of blood.

Feed System Cuts Auto Costs by Vaporizing Fuel Oil

DRIVING AN AUTOMOBILE 200 miles on 25 cents worth of fuel oil would be a cinch, according to Joseph E. Blanding, of New London, Conn., if its engine were fitted with a fuel feed system he has invented. This device, which converts low-compression, spark-ignition engines into compression-ignition engines, causes the fuel oil to be completely vaporized as it is sucked into the cylinders, Blanding states. This complete vaporization makes possible efficient combustion without the use of the injectors and high compression ratios found in conventional Diesel engines which operate on similar, or an even more refined, fuel. Blanding has designed a special engine for use with this device, but has used it on ordinary marine and automobile engines.





How a cross-ruled glass screen, placed over a full-face photograph, measures the width and height of the features. Proportions of the normal face are 23:28. Filed photographs are cross-classified as medium, narrow, or full, as illustrated at the left, to aid officers in translating a description into terms of the code

Police Identification System "Fingerprints" Faces

FACES are classified like fingerprints, to index hundreds of thousands of portraits, in the criminal files of Los Angeles County, Calif. A ruled glass screen called a "physiognomograph," applied to each photograph, enables experts to determine accurately such information as facial height and width, and the size and shape of nose and mouth. Characteristics also noted include position of the ears, height, weight, general build, and the color of hair, eyes, and complexion. Finally, all these items are ingeniously combined in a number-and-letter code symbol, such as 11/5 NUFCLHD, under which the picture is filed.

As a result, a victim or witness of a crime—say, a holdup—need not thumb through hundreds or thousands of photographs, which may serve only to

confuse his memory. He simply gives the best description he can of the crook. This is translated into the corresponding code symbol, and perhaps as few as a dozen photographs answering the description come from the files for possible identification—all the "impossible" ones being automatically eliminated. As little information as the approximate height and one facial characteristic of a criminal may lead to his capture, although every added detail helps narrow the search.

Deputy H. C. McDonald of Los Angeles measures a photograph with the screen. Filed under the ingenious letter-and-number system, it can be located at once to aid identification



SECRET PROCESS PROMISES EXPLOSIVES FROM CORNCOBS

MORE THAN 3,000,000,000 corncobs which annually go to waste may be converted into explosives for defense of the nation, as a result of recently discovered methods for treating cobs. Following successful experiments by Francis E. Wilkinson, of Glendale, Calif., a plant has been erected at Missouri Valley, Iowa, to convert 40 tons of cobs daily into cellulose explosives, synthetic rubber, and gums.



For six years Wilkinson has dreamed of founding a new industry on corncobs. Late in 1940, a group of Iowa business men visited his back-yard laboratory to inquire whether he could find some way to convert wasted cobs into defense products. To their amazement, he replied he could complete the job in 60 days. "What they did not know," he chuckles, "is that I had been hard at work on the problem since 1935."

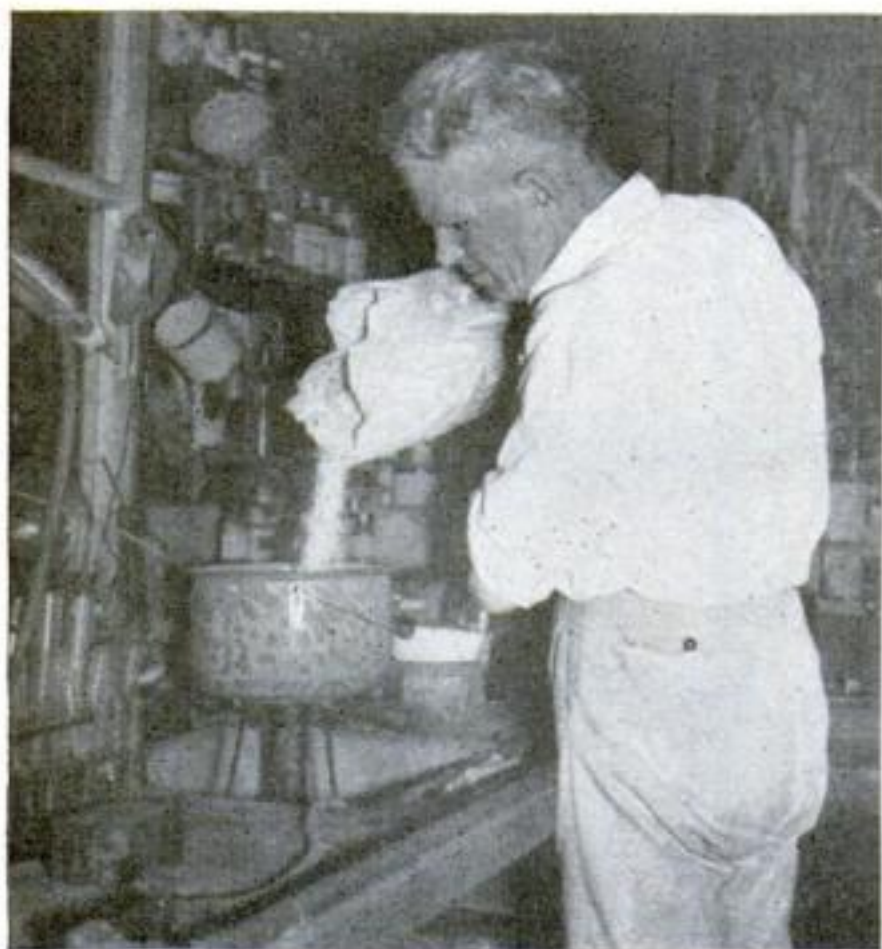
To extract cellulose, Wilkinson grinds the cobs and boils them, the solids being cellulose. After filtering, he evaporates the liquor down to a thick sirup. This liquid contains gums, valuable for tires and plastics. With the addition of two secret processes, this laboratory method will be applied in the Iowa plant on a large scale.

Dr. Lionel K. Arnold reported recently in the Iowa State College bulletin that corn stalks yield 25 products, husks 15 and pith 20. To cobs he ascribed 48 uses, from acetic acid and diabetic food to resin. Cobs cost virtually nothing, and Wilkinson believes his method will give the United States alcohol, guncotton, motor fuel and gunpowder in vast quantities.

Waste corn cobs from Iowa are broken up and ground in California backyard laboratory as first step in giving Uncle Sam a new, cheap source of explosives

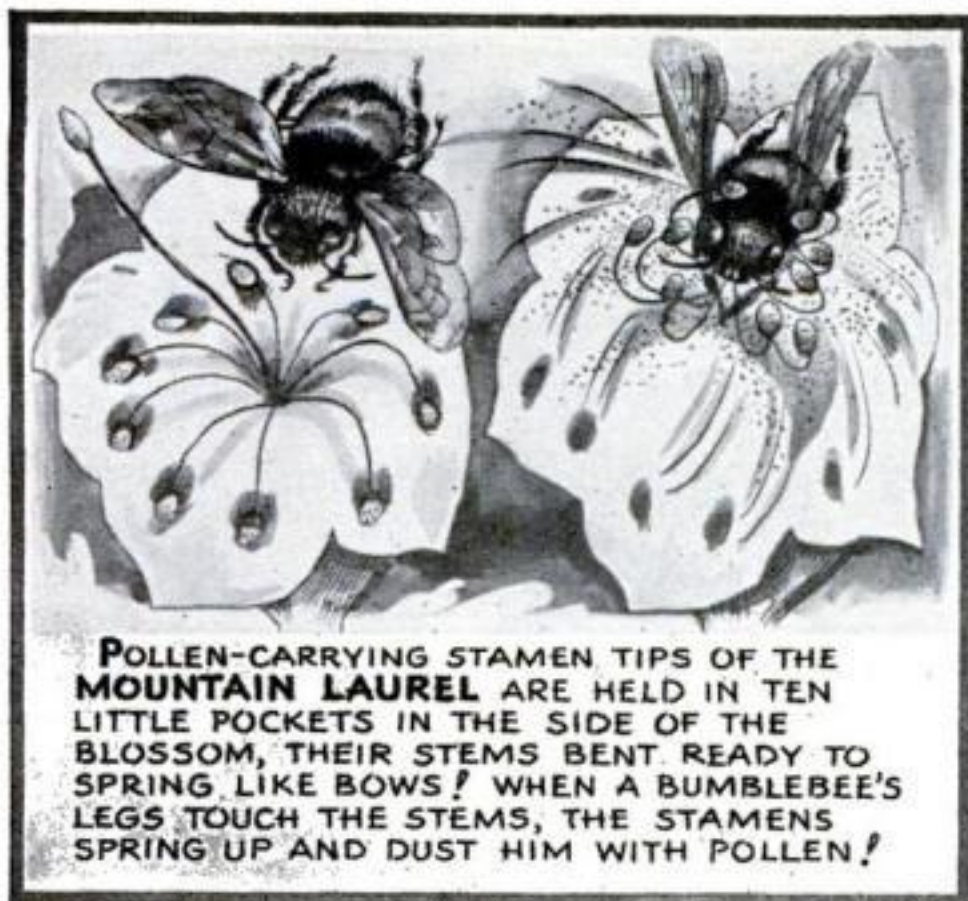
Boiling comes next, and ground cobs leave mass of solids—cellulose—the first defense product to be salvaged. The liquid is carefully poured off

Liquid is then evaporated to a thick sirup which contains gums, valuable for tires and plastics. A plant has been put up in Iowa to utilize process



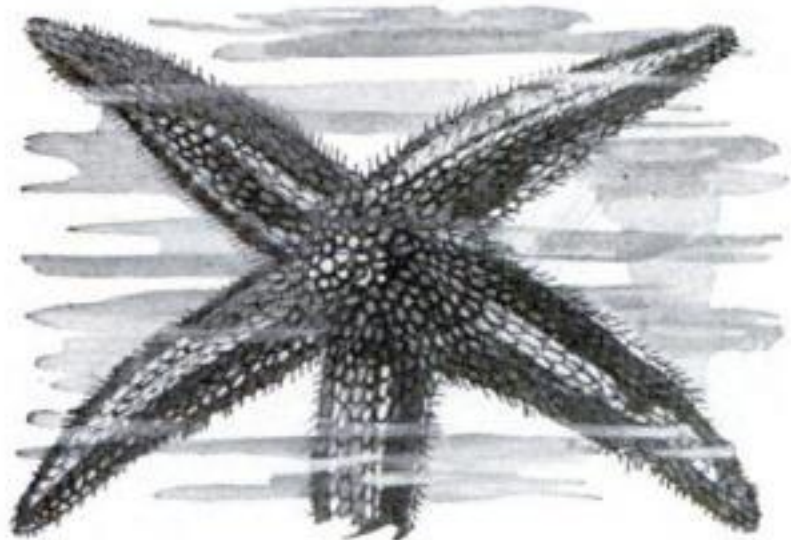
Un-Natural History

BY
Gus Mager



POLLEN-CARRYING STAMEN TIPS OF THE **MOUNTAIN LAUREL** ARE HELD IN TEN LITTLE POCKETS IN THE SIDE OF THE BLOSSOM, THEIR STEMS BENT READY TO SPRING LIKE BOWS! WHEN A BUMBLEBEE'S LEGS TOUCH THE STEMS, THE STAMENS SPRING UP AND DUST HIM WITH POLLEN!

NATURALISTS SAY THAT **BULLFROGS** USUALLY REPEAT THEIR DEEP BASS SONG, "BETTER GO ROUND, BETTER GO ROUND," SEVEN TIMES BEFORE PAUSING! ONLY RARELY WILL ONE MAKE IT SIX OR EIGHT TIMES!

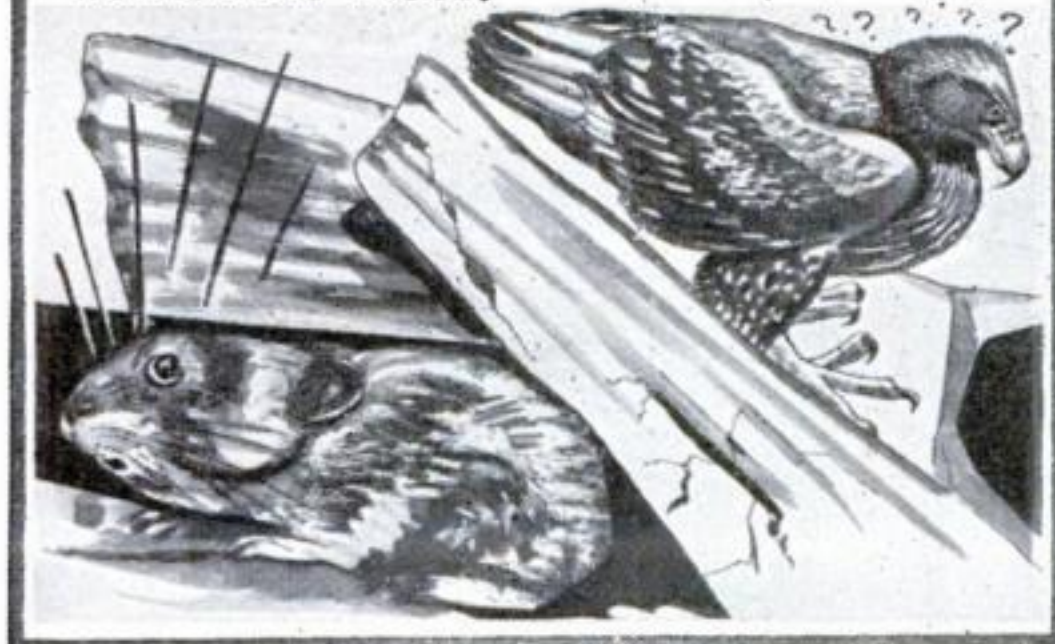


IF ONE OF THE FIVE ARMS OF THE COMMON **STARFISH** IS BROKEN OFF, ANOTHER GROWS IN ITS PLACE! STRANGER STILL, IF YOU CUT THE STARFISH IN HALVES, A COMPLETE STARFISH WILL DEVELOP FROM EACH HALF!



WALKING FERNS CAN TAKE STEPS TO MAKE PROGRESS! LEAVES REACH OUT IN TAPERED PROBES WHOSE SLENDER TIPS TAKE ROOT TO FORM NEW PLANTS! IN THE SECOND SEASON THE LEAF CHORD DIES, SEPARATING THE NEW PLANT FROM ITS PARENT!

PERHAPS THE ONLY MAMMAL VENTRILOQUIST IS THE **PICA**, A ROCKY MOUNTAIN RODENT! EACH TIME THE LITTLE ANIMAL SQUEAKS, ITS SHRILL VOICE SEEMS TO COME FROM A DIFFERENT PLACE, TO THE CONFUSION OF ITS ARCH ENEMY, THE HUNTING EAGLE!



DAMSEL FLIES COMMONLY FLY TANDEM, THE MALE GRASPING THE THORAX OF THE FEMALE AND FLYING IN FRONT OF HER ON HER EGG-LAYING EXPEDITIONS! HE EVEN GOES UNDER WATER WITH HER TO PLACE EGGS ON SUBMERGED PLANTS!



NATURAL CEMENT COMES BACK

**A 110-Year-Old Industry Booms Again
As Engineers Discover a Recipe for
Making Concrete Roads Last Longer**

By WALTER HOLBROOK

HIGHWAY engineers have found a way to have their cake and eat it, too, and as a result the natural-cement industry, dead for 40 years, is staging a sensational comeback. By mixing natural cement with the synthetic product which once drove it off the market, engineers have discovered a highway material that blends the durability of the one with the quick-hardening quality of the other.

The foundations of the National Capitol, Brooklyn Bridge, and the Statue of Liberty were all built with a cement mined at Rosendale, N. Y., and today they look as if they had been put up only last year. The automobile age, however, was impatient of the month it takes the natural product to harden, and turned to synthetic or "Portland" cements which did the job in a week. After a few years the synthetics began to show signs of wear and by 1930 there was considerable agitation for making them more durable. Some states stopped building concrete roads altogether.

Then along came an engineer named Bertrand H. Wait. He had been impressed with the toughness of old Rosendale cement houses and culverts he had seen near the mine in 1910, when he was helping build New York City's Catskill Aqueduct, and it oc-

Pneumatic drills make holes for blasting at mines of the Century Cement Manufacturing Co., Rosendale, N.Y. Though cement has been mined here for 110 years, methods have changed little

Placing the dynamite charge for a blast. After the explosion, the rock is broken up with a sledge hammer into pieces that are small enough for one man to lift and load into trucks or cars to go to the kilns



curred to him that the old Rosendale and synthetic cement might be blended in such a way that it would be both lasting and quick-hardening. He started experimenting in 1933, and soon evolved blends 12 times as resistant to freezing and thawing in salt solutions as ordinary, synthetic cements, yet so strong the forms could be taken down at the same time they would be if the ordinary cement were used straight. He persuaded New York State's Commissioner of Highways to try a blend of one sack of Rosendale with six sacks of ordinary cement.

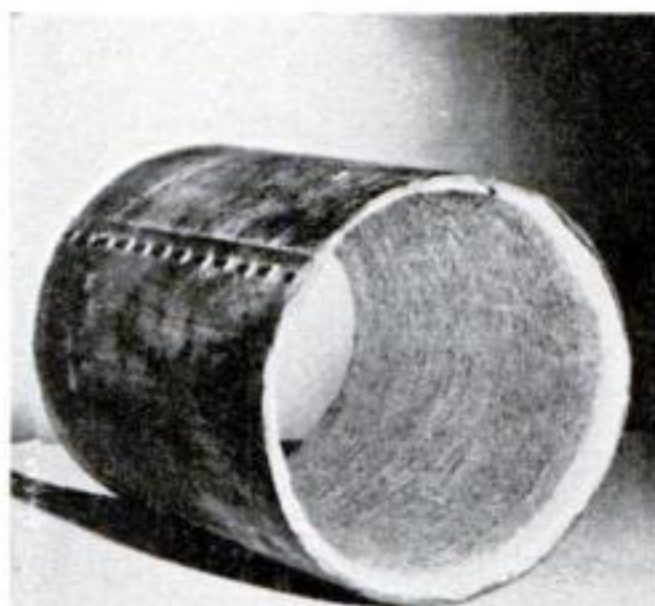
The first blended road was put down in the summer of 1934 at New Paltz, N. Y., only ten miles south of the 110-year-old mine. The next year the State began using the blend on steep grades and curves, and in 1937 made it standard for all its highway construction. Vermont, New Hampshire, Massachusetts, and Maine soon did likewise. Rosendale, a town of 1,000 population, boomed, and owners began pumping water out of natural-cement mines from one end of the country to the other.

A blend of two sacks of Rosendale to five of ordinary cement was used in the construction last May of the largest cofferdam seal ever poured in the East. This stopper at the bottom of a bridge piling was in the Gowanus Canal, at Hamilton Avenue, in Brooklyn. The New York State Department of Architecture uses blends now for all its foundations and cellar floors, but four fifths of the 1,000,000 sacks produced at Rosendale last year went into highways. Recent tests have indicated that

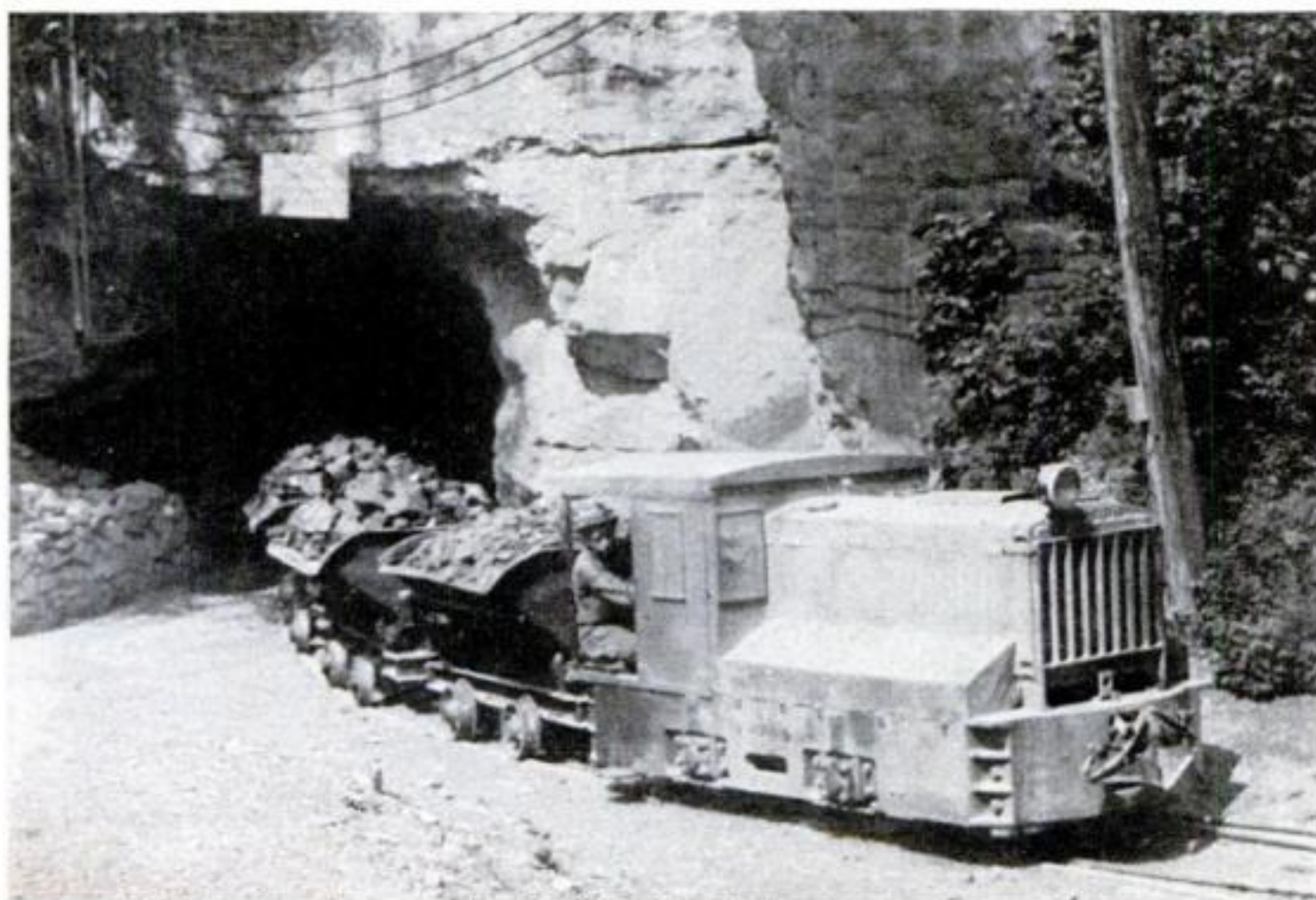


In the construction of the Bronx-Whitestone Bridge, in New York City, Rosendale blend was used in sealing cofferdams and concreting one pier

The section of water main below was in service for 84 years at Plymouth, Mass. The outer shell is of wrought iron, the lining of Rosendale cement



Above are two slabs of highway concrete after three years of service. The slab at top is made of Portland blended with the natural cement; the lower slab is made of the Portland alone



A gasoline locomotive drags a string of cars loaded with rock out of one of the Rosendale mines. Two of the openings are big enough for a car to be driven into them; some rock is removed in trucks

blends are superior to straight synthetics for air-raid shelters. They do not shatter so easily, and when big enough charges of T.N.T. are used to break them up, they split into bigger pieces which do not fly as far, thus reducing the danger to people in the vicinity.

An outcropping of the Rosendale deposit was discovered in 1825 on the farm of Jacob Snyder, an old Dutch settler, during the building of the Delaware & Hudson Canal, which ran right past Snyder's front door. Snyder started commercial development five years later, though for the first 30 years the cement was used largely for mortar. Its lasting quality under water, however, plus the invention of the concrete mixer in 1860 led to its increased use in concrete, and in 1899, the peak year for natural cement, 17 companies took more than 4,000,000 barrels out of the Rosendale mines.

As the business flowed away to the synthetics, 15 of the companies combined to try to produce a quick-hardening natural cement to meet competition. They failed and soon the only mine operating was the oldest, the one developed by Jacob Snyder. Through the lean years Snyder's grandson and great-grandson continued to mine the rock for mortar, still a profitable segment of the business. The great-grandson, A. J. Snyder, bought up a couple of the abandoned mines, and today is general manager of the Century Cement Manufacturing Co., the only firm operating at Rosendale.

For several years Century has doubled its production each year, and in 1941 Snyder expects to take nearly 500,000 barrels from the three mines he is working. There is little fear of the vein being worked out for another 100 years, for it is known to be at least eight miles long, five miles wide, and 22 feet thick.

Snyder mines the rock much as his great-grandfather did, except that air instead of steam drills are used to bore holes for the dynamite. The shaft kilns used in burning the rock have been in service for 50 to 100 years, though they must be relined annually with firebrick.



Sandwiched between layers of No. 2 buckwheat coal, the rock is packed in 40-foot kiln shafts. These kilns have been used for 50 to 100 years, with occasional relining with fire brick



Burning is a continuous process. Twice a day, a sixth of the rock is drawn off through a door in the bottom of the kiln, and more of the raw material and coal is fed in at the top

Crushed by hammer mills beside the kilns, the rock is carried in basket trolleys to the mill where it is pulverized and screened. After testing, it is sacked as below for shipment

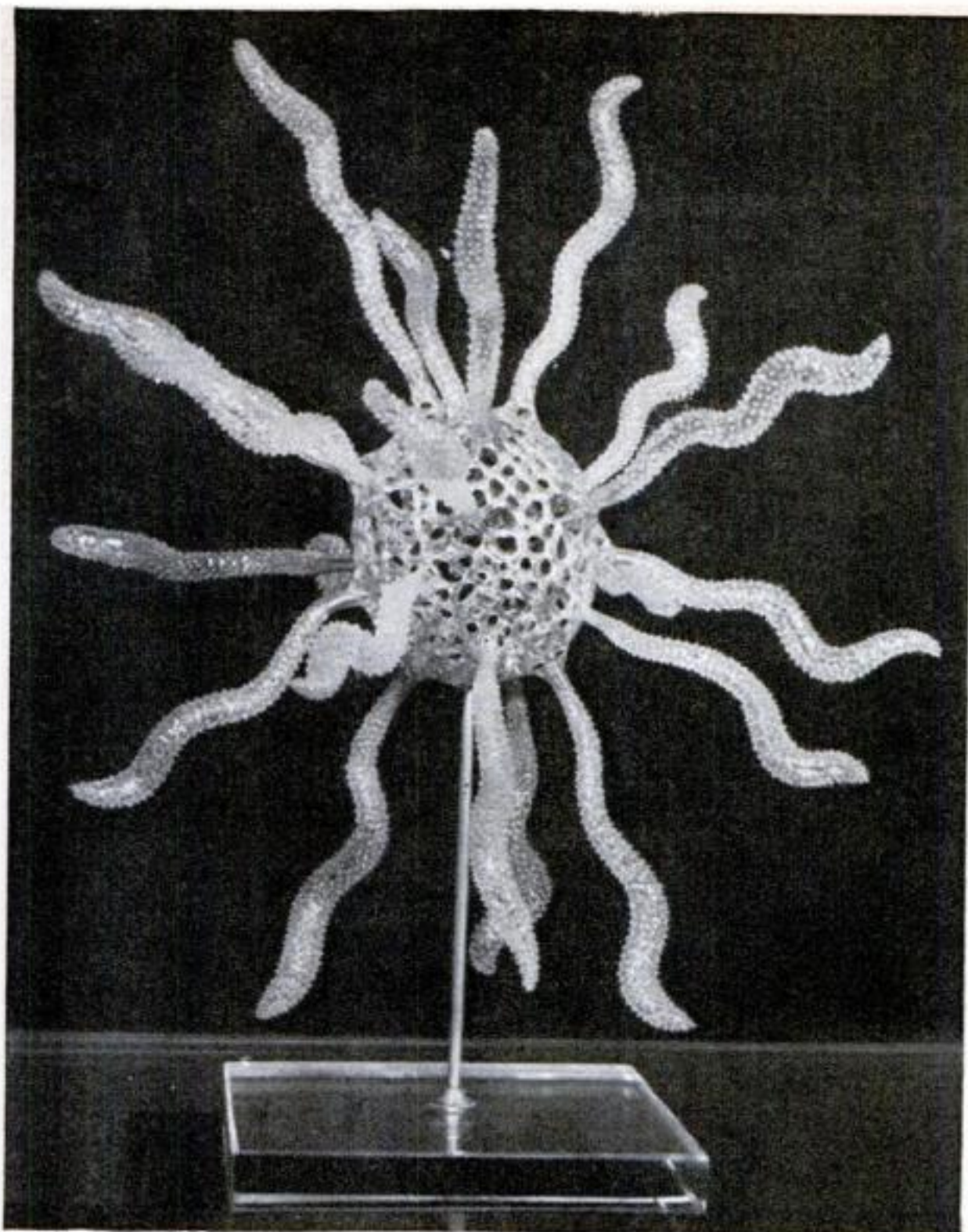


GLASS SCULPTOR

MODELS MICROSCOPIC LIFE

MOLDING glass into vastly enlarged copies of microscopic organisms has kept Herman Mueller busy for 35 years. Working with a Bunsen blowtorch and ordinary soft lime soda glass, he has made more than 1,000 scientifically accurate reproductions of infinitesimal living organisms.

His work is used by the American Museum of Natural History in New York City to depict the wonders of living things that are invisible or almost invisible to the naked eye—the plant and animal jungles that exist in drops of



A siliceous skeleton of a radiolarian, one of the minute organisms found in tropical seas, modeled in glass by Herman O. Mueller for the American Museum of Natural History in New York City

Mueller at work on one of his scientifically accurate and at the same time beautiful creations. He uses a soft lime soda glass, shaping the tubes or rods with the aid of a Bunsen blowtorch



water. Some of his creations require months of painstaking work for completion, and each must be approved by scientists before it is placed on exhibition.

Mueller, whose family had been glass blowers for 150 years in Thuringia, Germany, before he came to the United States in 1893, makes practically all of his reproductions from glass tubes an inch in diameter, or quarter-inch-thick glass rods. He works from water-color paintings turned out by a staff of four Museum artists, from microscope slides, and occasionally he visits a laboratory on his own to get some first-hand information on his subjects. The finished products are colored with oil

paints that are blown on with air brushes.

Mueller's greatest work was the reproduction of the creatures in a quarter of an inch of pond bottom magnified 1,000,000 times. That took him five years. Mounted in a six-foot showcase now, the exhibit contains 73 types of crustaceans, rotifers, water mites, insects, hydroids, protozoans, flowering plants, algæ, desmids, and diatoms, arranged in a natural setting.

Perhaps the hardest assignment he ever had was to make a model of a sand flea, a shrimplike crustacean about a quarter of an inch long. Each of the half dozen segments of the flea's body had to be blown as a separate piece. Then each section of the legs had to be made separately. There were five pairs of walking legs, seven pairs of swimming legs, and three pairs of maxillipeds, which are a cross between legs and mouth parts.

For all the exasperating labor the flea required, it did not have nearly as many parts as Mueller's 11-inch-wide reproduction of a globigerina, a protozoan of the class *Sarcodina*, which has hundreds of delicate spines four inches long radiating from it on all sides. This, incidentally, is the minute organism whose shell comprises most of the chalk cliffs of Dover. Although it is microscopic, its shells make up 70 percent of the ocean bottom for several hundred feet deep in many places.

Apart from the remarkable faithfulness with which the models reproduce nature, many of them are objects of rare beauty in themselves, displaying a gorgeous variety of forms and designs. One of the handsomest is a model of one of the radiolarians, a protozoan called *Dorcodospyris dinoceras*, which lives at a depth of 2,900 fathoms in the Indian Ocean. It resembles a two-dimensional front view of a royal crown. Two arms curve downward like the sides of a crown, and a globular object like a gem is set at the top center.

Mueller says that as far as he can tell, the use of glass for scientific models of living things in this country goes back about 50 years, to the time when Harvard University commissioned the Blaschkas, a father and son living near Dresden, Germany, to make models of flowers. The Blaschkas did all their work in Germany, however. Lately, the Field Museum in Chicago and the Carnegie Museum in Pittsburgh have commissioned American glass blowers to make models of microscopic life, but Mueller, at 62 years of age, seems to remain the undisputed dean of his remarkable specialty.

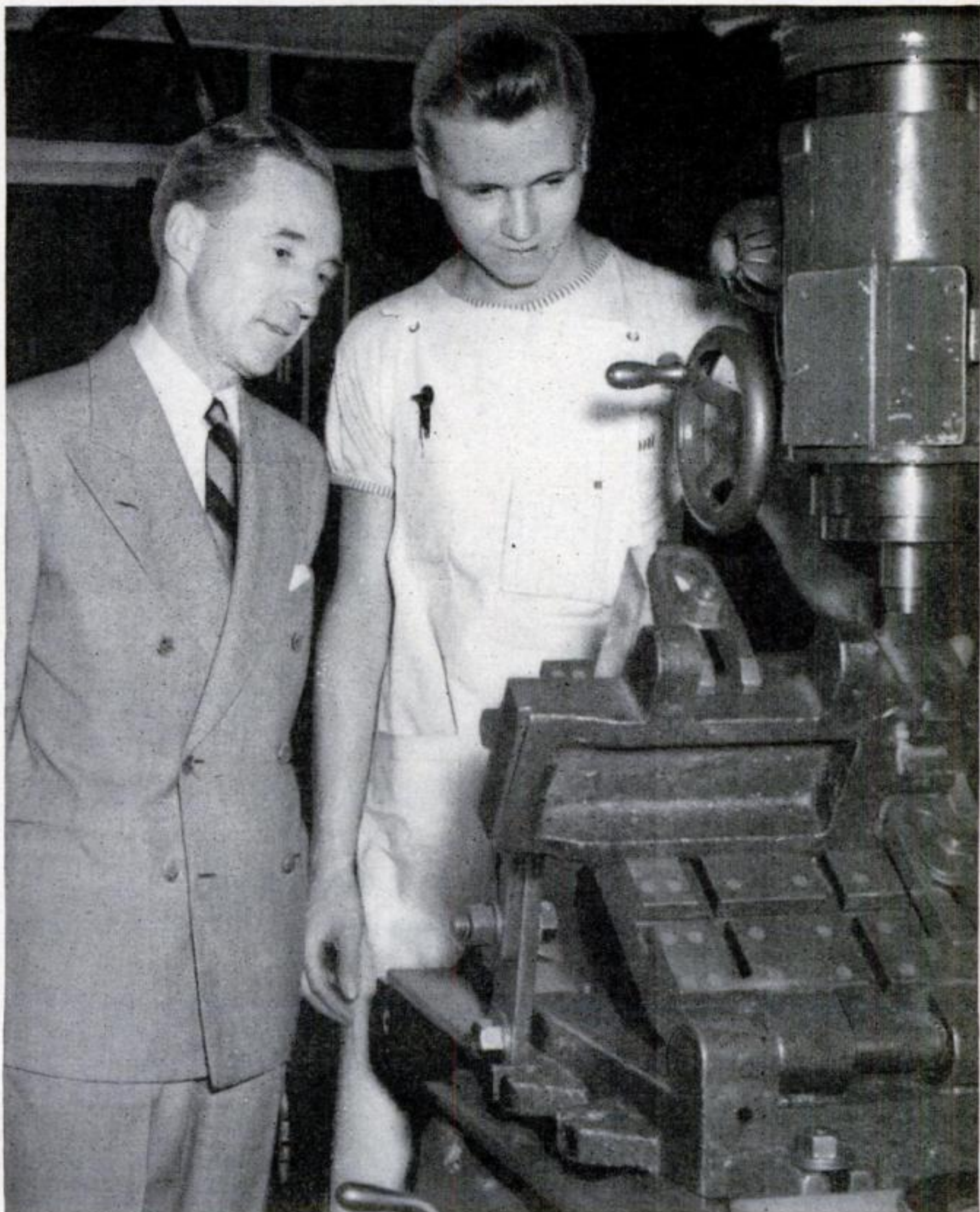


Heating a tube over his burner flame, the scientific sculptor blows a round bubble from the molten glass. By inflating and drawing out the fragile material, he shapes it in imitation of nature's tiny creatures

Forming a large globe which will eventually become the umbrella of a jellyfish, he uses a pad of asbestos to prevent heat from escaping at the open end



AUTOS



**Edsel Ford Tells About
Trade Schools for Defense**

NEXT PAGE



Ford's Expanded Training Activities Help Break the Manpower Bottleneck in Emergency Industries

By SCHUYLER VAN DUYNE

WHETHER for war or peace, machines don't run by themselves. They need trained operators, and trained operators don't just happen. So reasoned Henry Ford 26 years ago when he established the first of the famous Ford Industrial Schools. Today, with six Ford schools training more than 10,000 men in basic industrial skills, Henry Ford, educator, is an essential counterpart of Henry Ford, industrialist.

Edsel Ford, president of the Ford Motor Company, summed it up to the writer this way: "The Ford Motor Company, and many others in the industry, are doing a bang-up job with one of the most perplexing of the defense assignments. We hope we won't be caught with the machinery, plants, and materials, and not enough men to operate them."

"And that goes for de-

fense, war, or peace. We want it to be for peace."

We sat at the desk of Frederick E. Searle, superintendent of the schools, after an inspection tour. The roar of student-operated machines still reached our ears from the three-acre student shop within the River Rouge plant at Dearborn, Mich. It was the same building, incidentally, where in 1918 the Ford Company built Eagle Boat submarine chasers for the U. S. Navy. Today it shelters the Ford Trade School where 1,800 boys from 12 to 19 years old are taught what it takes to become skilled craftsmen.

It is only one of six Ford schools, and another is being planned. Twenty-six years ago, Henry Ford founded the first of them, the Ford Apprentice School, when he assigned as full-time instructor an employee who was voluntarily tutoring six new shop men in machine-tool operations.



Edsel Ford, at left, tells the writer how the Ford Industrial Schools are helping train machinists for defense

"My father had long been keenly interested in education, and that was the real beginning of the practical application of his teaching ideas," Edsel Ford told me.

Where these ideas have led is one of the most astonishing chapters of the almost incredible Ford history. For one thing, Henry Ford's nonprofit schools have provided better-trained workmen. That's important. For another, they operate at next to no cost, despite their current expenses of \$15,000,000 a year. That's important, too. But of most importance to Henry Ford, educator, they have helped thousands of boys and men to support themselves while continuing their studies.

"That they are now helping the country man some of the defense factories with competent workers is of paramount importance today," Edsel Ford said.

Back of it all is a story of educational

pioneering born largely of the imagination of the senior Ford. Less than a year after the founding of his Apprentice School, in 1915, he organized the Henry Ford Trade School to fit youngsters with something more tangible than Latin and Greek for getting industrial jobs. That his efforts benefited the company came as a by-product rather than as an end.

"My father has always had such youths in mind, who were headed for his own or similar industrial plants," the Ford President said.

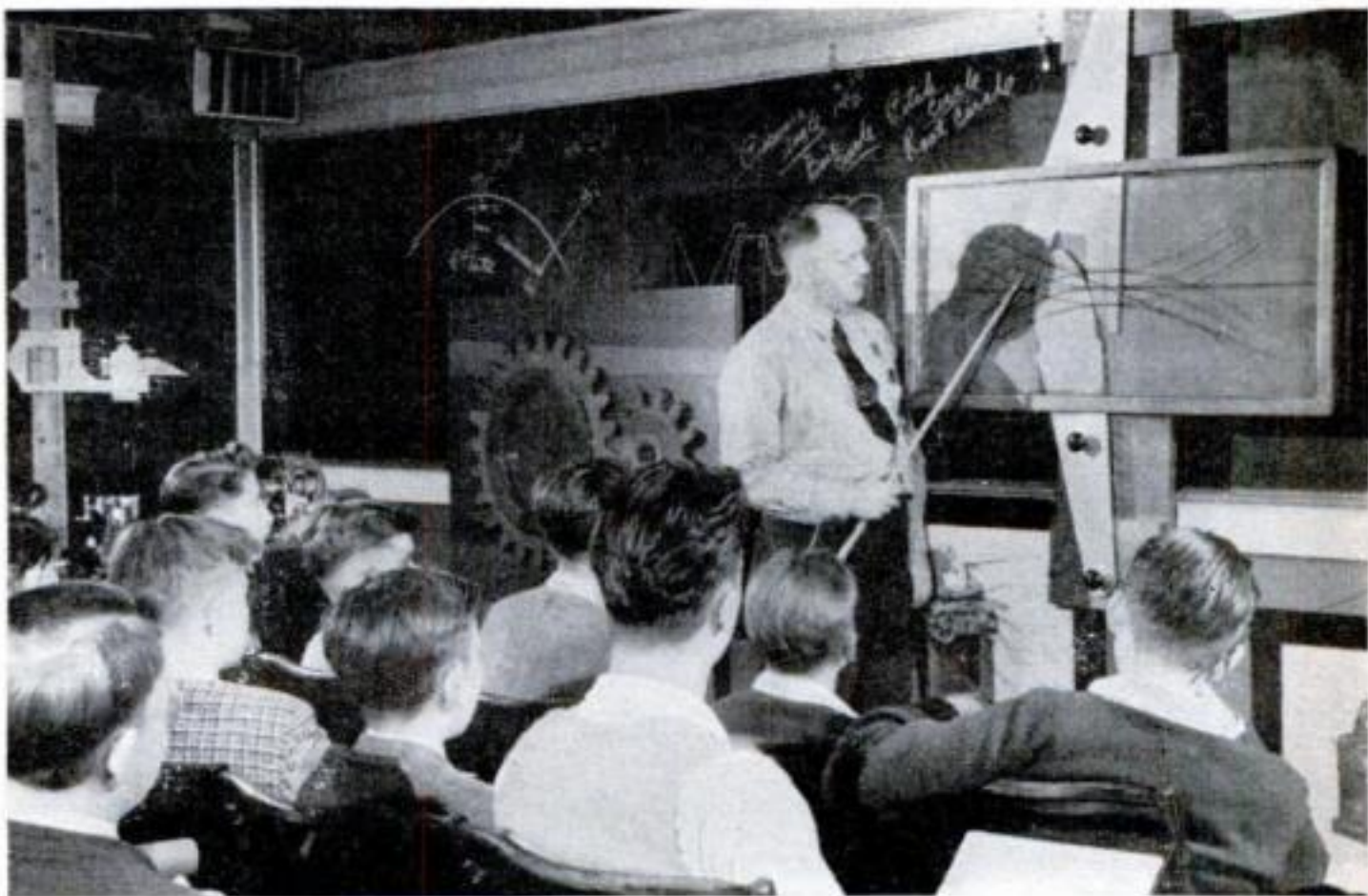
That other school men liked his ideas is testified to by the fact that many Ford students are enrolled on the local school-board recommendations. Others are recommended by ministers, civic leaders, and the juvenile courts. That the schoolboys themselves approve is shown by the fact that the school can accept less than one percent of the applicants, and that more than 75 percent finish the four to six-year course.

Henry Ford Trade School boys are admitted between the ages of 12 and 15. They complete their training at 18 or 19, and then are offered jobs with the Company. Each boy gets three weeks' vacation in the summer and one at Christmas. His time is alternated with a week at class work and two weeks in the shop. He is paid a cash scholarship of 20 cents an hour to start with, and the rate is adjusted seven times a year according to his progress. If he applies himself, he may get as much as 45 cents an hour before completing his class work. When all his time is spent in shop training, it may reach 90 cents. In addition to his pay,



Two students use a drill press in repairing a piece of shop equipment. The boys in the Trade School have the job of servicing thousands of tools in the Ford plants

Classroom teaching supplements actual shop work. A Trade School boy spends one week at class for each two weeks in the shop during his four years of training. He learns order, time value



the school also gives him \$2 a month to maintain a regular bank savings account, and it checks his bankbook monthly while he is there. He also gets a daily hot lunch, free. The three items—scholarships, thrift funds, and luncheons—totaled more than \$1,500,000 in 1940.

During his four years of class work, the boy studies mathematics, shop theory, and drawing, in addition to English, civics, economics, auto mechanics, physics, chemistry, qualitative and quantitative analysis, and metallography. Safety, orderliness, accuracy, and time values are drilled into him, and he learns the dignity of necessary work by taking his turn at sweeping floors and cleaning windows.



Thrift gardens give the youngsters a taste of outdoor work. When they get to be machinists, they will know how to plant their own gardens and raise fresh vegetables for themselves

It isn't all work and no play, either. Singing and other group activities break the monotony of shop and classroom. Civics, economics, and English supplement technical studies



But it is mainly the shop work that the Ford Company itself provides for the boys that sets the school apart from the ordinary vocational school. For it is 100-percent practical work for both boys and the Company. Actually, the making and maintenance of tools is the Trade School's part of the work schedule of producing Ford cars, and, by a system of credits, or "sales" of work done for the Company, the financial return to the school almost equals its operating expenses, thus making it practically self-supporting.

Thus, beginners are assigned to salvaging broken or badly worn small tools from the Ford assembly lines, whenever they are returnable to productive use. The youngsters, as they repair them, familiarize themselves with handling them, learn their uses, and come to understand their design. Thousands of screw drivers, wrenches, oil cans, shears, hack-saw frames, hammers, and the like pass through their hands, while from 400 to 700 factory safety goggles are put back in good repair by the boys each day.

Later, the boys learn to make tools such as cutters, reamers, and drills, and to repair precision tools. In a month, they may overhaul 350 pairs of micrometers and 4,000 dial indicators. In addition, the Trade School pupils completely built and constantly maintain the 130 miles of chain conveyors that wind through the Rouge plant.

Every student spends some time in each of the training shop's 25 departments. At his service are more than \$2,000,000 worth of power machinery, rented to the school by the Company for \$10,000 a month.

Edsel Ford commented: "You can readily see why boys who complete the courses are well equipped to enter the Ford Motor Company or other manufacturing plants."

So we could!

The Ford Apprentice School, oldest of them all, is also close to the hearts of the Fords, father and son. It has about 6,000 students today. All Ford apprentices must attend its classes and shop courses, while any Ford employee may attend the latter. The men go to classes two periods a week for three years, before or after their regular hours, and, as in the Trade School, their class and shop problems are practical, becoming actual production-

line problems almost at once. Under the guidance of shop instructors, the men are put through training in the use and maintenance of shapers, lathes, millers, grinders, and benches. They begin at 75 cents an hour and are immediately eligible for advances based on their progress.

It was six years ago, at a time when unemployment throughout the country was a fearsome thing, that Henry Ford inaugurated still another school at Rouge—the Ford Training School. This was open to high-school graduates between 18 and 20. The avowed aims were to teach them a trade while retaining their interest in education, as well as “to get them off the streets.” The course, lasting three months, covers tool and die work, electrical repair, heat treatment, welding, or motor repair, and students begin at 55 cents an hour. The school handles 1,200 students a year. In May of this year, enrollment was upped to 620, with 60 instructors, and the records show that 4,094 have completed the training and been placed in the Ford plant. The graduates represent 283 high schools. An illuminating commentary is furnished by the fact that of 1,791 boys graduated from high schools in and around Detroit in January, 1940, 1,200 applied for admission at the Ford Training School.

It was months ago that the Fords recognized in the coming defense emergency the need for expanding their schools to meet the employment problems sure to arise with completion of their defense plants. The agreement of automobile manufacturers to cut car production 21 percent—perhaps much more—in 1942, and to continue the new models for two years, would only partly meet the problem. For, while it would release skilled workmen from civilian manufacture, even these workers would be at best partly trained for such tasks as building airplanes and airplane engines.

It was then that the wisdom and experience gained in the three Ford schools were thrown into the task of creating three new schools. Actually, the first new school was formed to satisfy a more immediate defense problem; that of aiding in the instruction of U. S. Navy recruits in the maintenance of battleships and other seagoing craft under construction and nearing completion.



Repairing safety goggles for Ford workmen is one of the many chores performed by Trade School boys. From 400 to 700 pairs of the protectors pass through their hands in a day

In the Ford Navy Service School, Uncle Sam's new sailors from the Great Lakes Naval Training Station are taught to man and maintain the machinery used on modern battleships



It is now in operation as the Ford Navy Service School, teaching upwards of 1,500 of Uncle Sam's new sailors from the Great Lakes Naval Training Station each three months how to man the machinery of intricate modern battleships. Plumbing, electricity, steam and Diesel engines, operation of machine tools and of repair-shop instruments, practical physics, mathematics, chemistry, and design, are some of their subjects, hammered into the men in the main Ford tool shop by Ford and Navy instructors.

To house the students, Henry Ford built and turned over to the Navy for \$1 a year a group of barracks for 1,500 men. They stand on the bank of the River Rouge, within

the Ford plant, and landing piers on the river bank permit Great Lakes Naval craft to dock virtually at their front doors.

Of comparable importance are the two other new schools, one already operating, established to train men for Ford's two new defense plants. One of these plants, at Dearborn, has begun filling an initial order for 4,236 2,000-horsepower Pratt and Whitney airplane engines. The other, at Willow Run, 20 miles away near Ypsilanti, is soon to go into production on assemblies and complete Consolidated B-240 four-engine heavy bombers.

Each of the new plants was built with schoolrooms. Early in June, classes opened in the Ford Aircraft School at the engine plant, where three floors are devoted to ten lecture rooms, four laboratories, and four drafting rooms, designed to handle 3,000 students. And soon to be opened is the Willow Run Aircraft School, with still more capacious class rooms adequate to its needs.

All of the operating Ford schools are now geared for all-out emergency training of their pupils. According to Edsel Ford, they are treating defense needs as of first importance, ordinary civilian manufacturing needs being placed in the background whenever it is deemed necessary.

The Ford president is the last to imply

that his organization is the only car builder training men for the special tasks of defense industry. For other car makers and industrialists with defense orders are undertaking similar solutions to their skilled-labor problems.

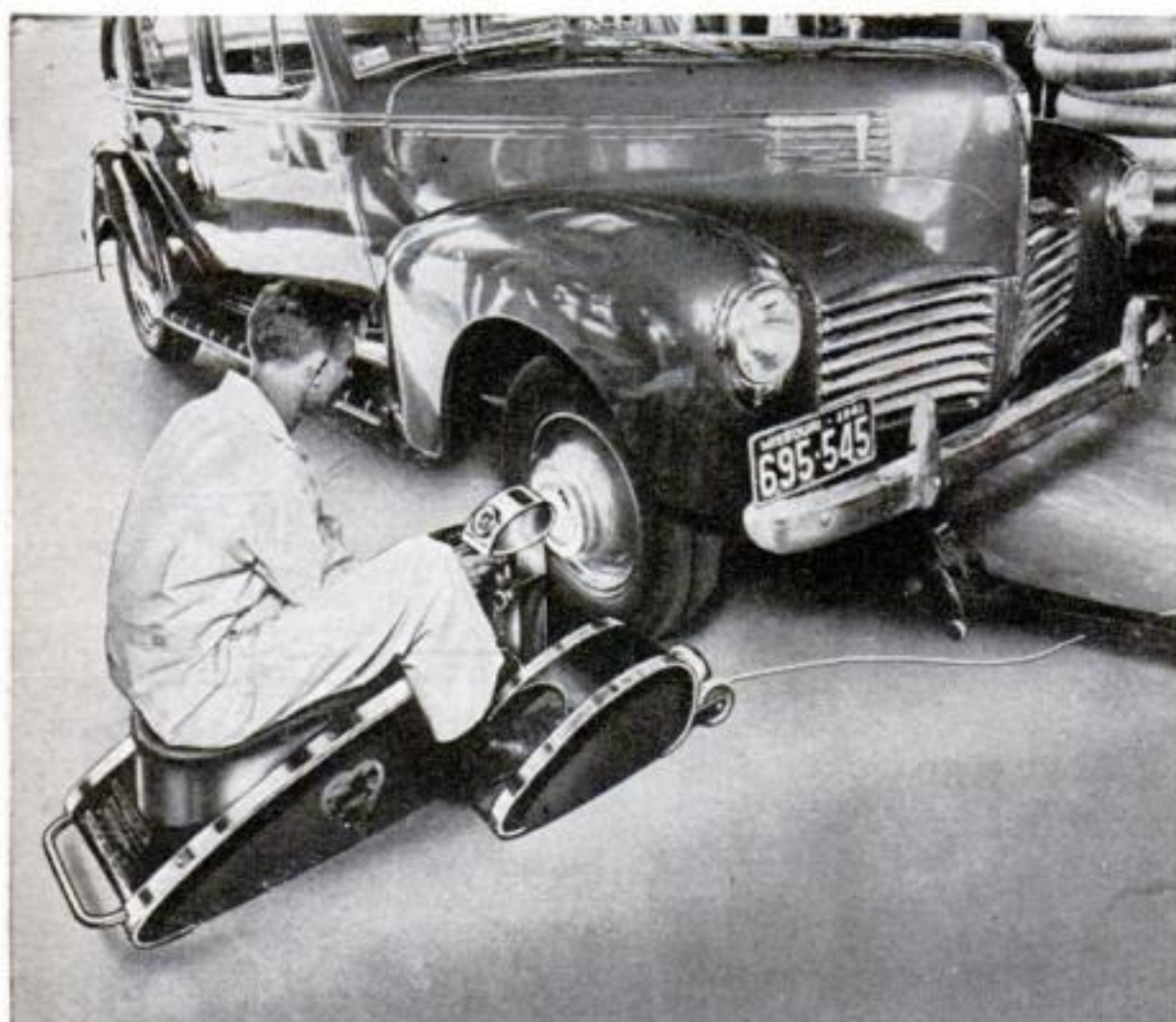
"We," he declared, "thanks to my father's far-sightedness in establishing industrial schools long ago, feel particularly well equipped for the training tasks in hand."

You will find schools directly patterned after those at Dearborn as far away as India, I learned, and in many other foreign countries. One at Jam-Shed-Pur, for example, 50 miles from Calcutta, was established by a Ford graduate 13 years ago. It trains men for the gigantic Tata Steel and Iron Company there, which employs 50,000 workers.

During June, the Government sent nine men to the Ford school superintendent to learn the school's methods to aid in preparing teachers for the U. S. industrial teaching program.

And when Detroit some months ago inaugurated its vocational-school, emergency-teacher-training program, it took over 35 Ford instructors for the task. Now, Detroit schools are open 24 hours a day seven days a week training workers with a staff of 300 instructors, largely Ford-trained.

Garageman's "Scooter" Spins Car Wheel to Test Balance

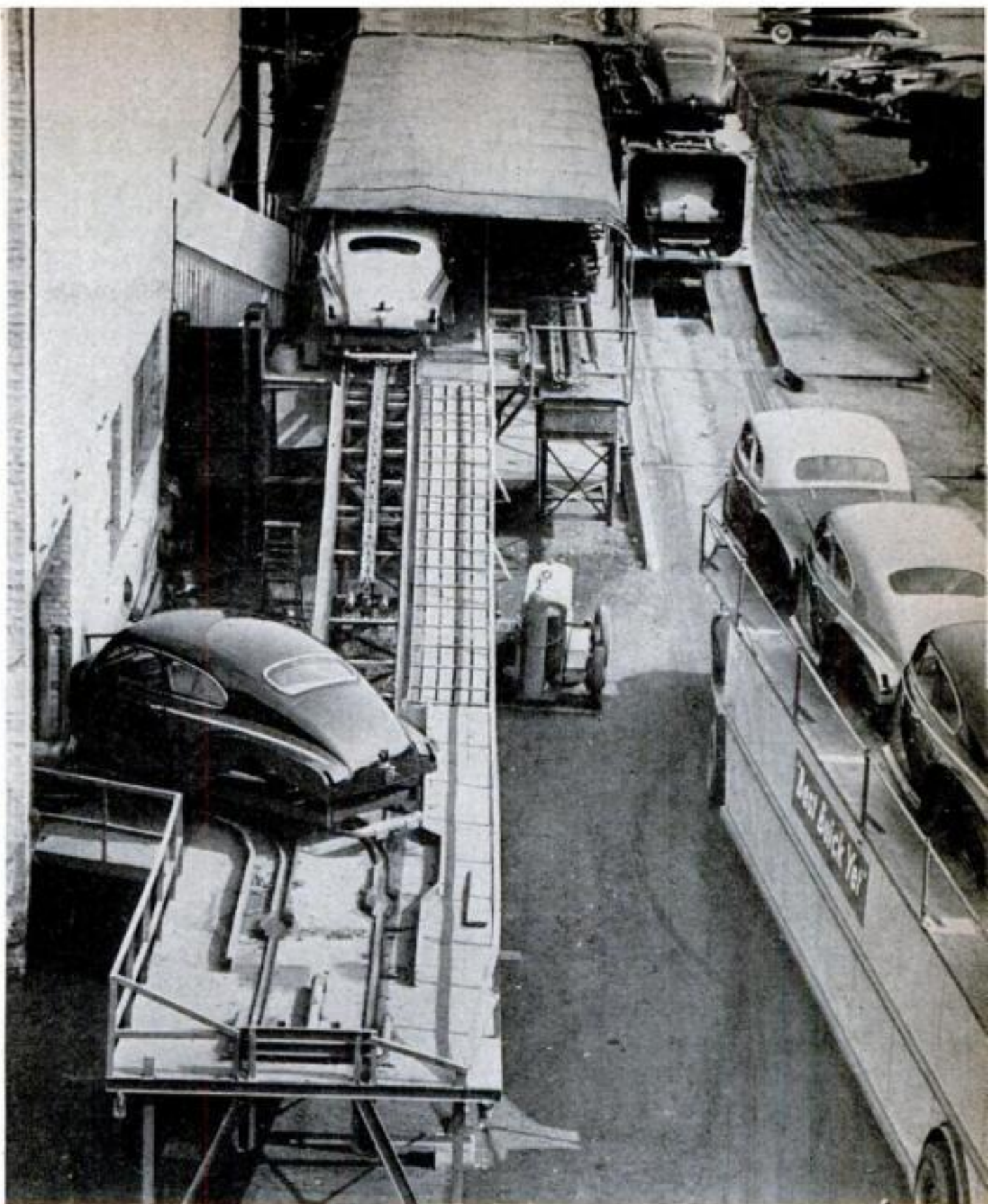


Testing an automobile wheel for balance with the handy new service device. A built-in electric motor turns the wheel at speeds as high as the equivalent of 125 miles an hour. Pedals control the motor and brake

MOUNTED astride what looks like a power scooter, the garage mechanic at left is testing the balance of a car wheel. When its built-in electric motor has been plugged into the nearest outlet, a spinner revolves the jacked-up wheel, simulating speeds up to 125 miles an hour. Controlling the motor with a foot lever, the operator thus can check the performance of the wheel upon its own spindle and bearings. A second pedal enables him to retard the speed of the wheel or bring it quickly to a full stop, by applying a brake. Easily moved, the compact tester measures less than four feet long, three feet wide, and two feet high. It is attractively finished in enamel with cadmium-plated trim.

A Roller Coaster for Auto Bodies Speeds Assembly

A TWO-STORY traveling bridge, equipped with tracks like a roller coaster, is the latest second-saver added to the assembly line of a big Flint, Mich., automobile plant. Trailers, carrying nine bodies at a time, arrive from the body works. They are pulled up on a ramp and the bridge slides into position behind them. The bodies, mounted on dollies, roll by gravity from the trailers onto the two-level tracks of the bridge, which then slides back into its original position. One after the other, the bodies roll down onto two levels of the assembly plant, swooping down the roller-coaster dip of the tracks, springing an automatic switch, and shunting themselves into the receiving room where the chassis are waiting.



Course Is Marked with Flour for Safe-Driving Contest



STRAIGHT lines of flour, laid down across a level field, provided a simple test for driving skill during a recent competition at Los Angeles, Calif. Each driver guided his machine down the level stretch, watching the lines of white dust and keeping his left wheels running along them. The marks left by the tires provided the judges with a check upon the accuracy with which the drivers kept their machines rolling along a perfectly straight course. Through this and other tests, the high-school boy and girl who handled their cars with the greatest skill were chosen the winners. Similar competitions were held in other parts of the country, where other sectional winners were selected for the finals in a nationwide safe-driving contest held at Dearborn, Mich.

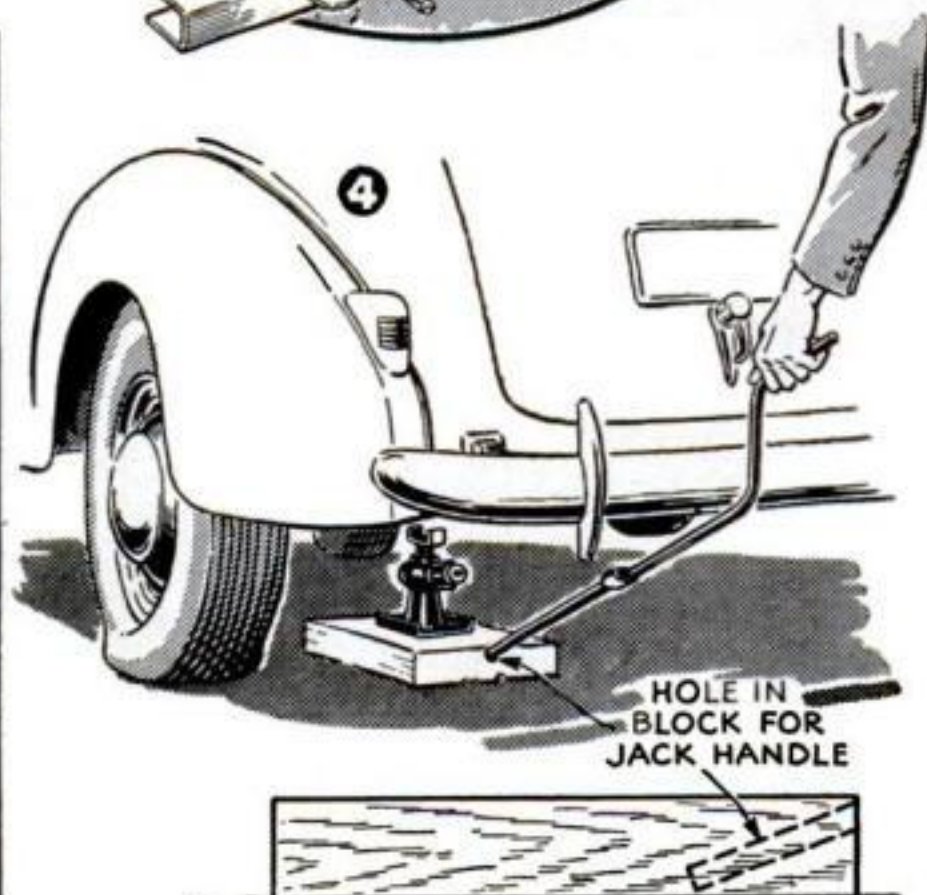
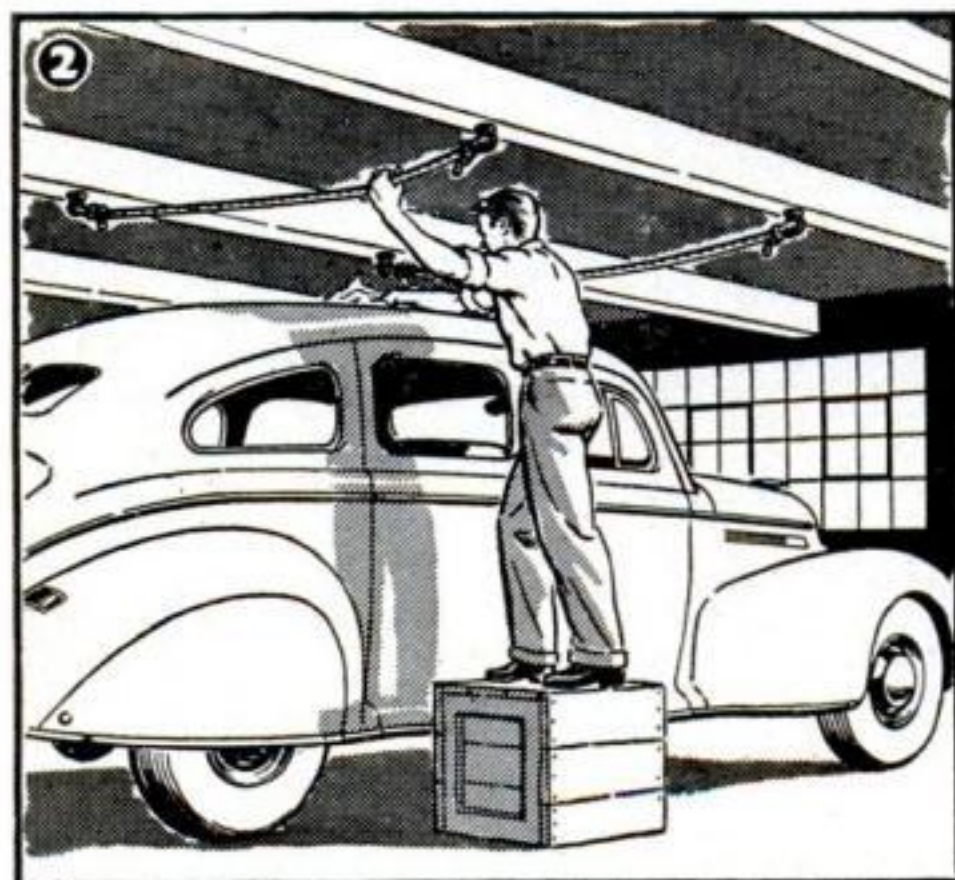
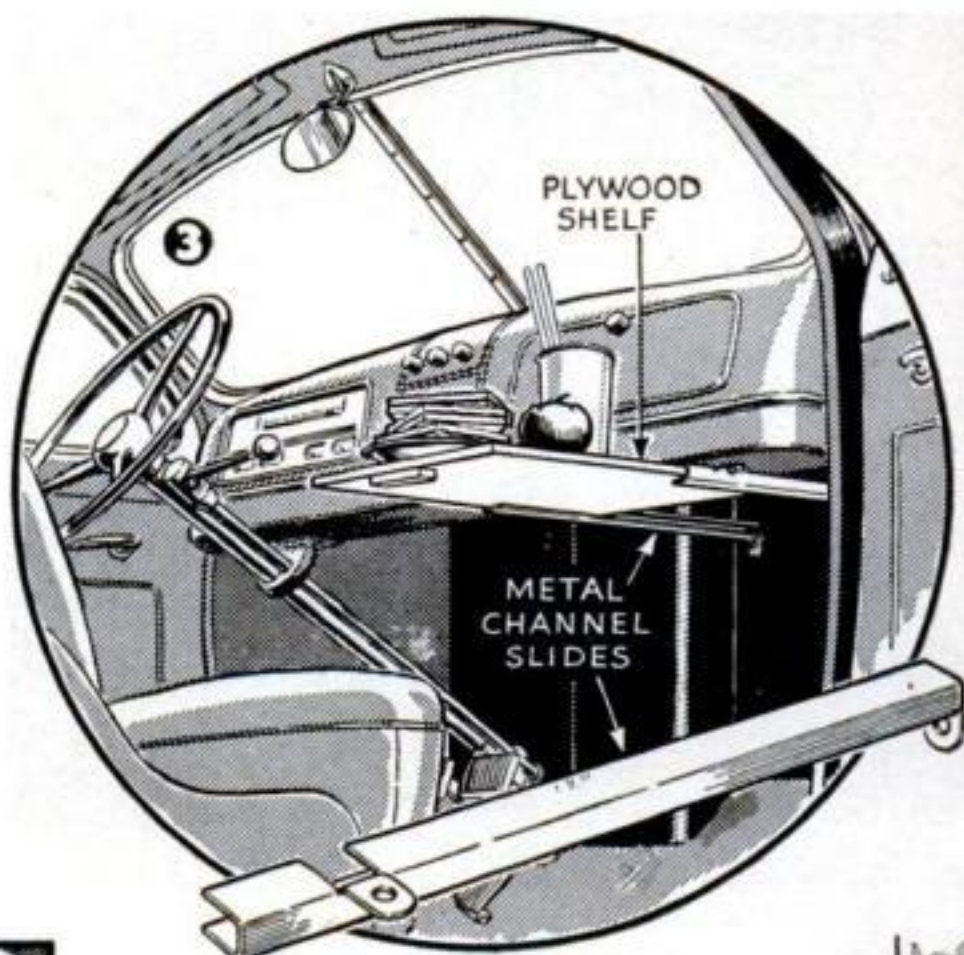
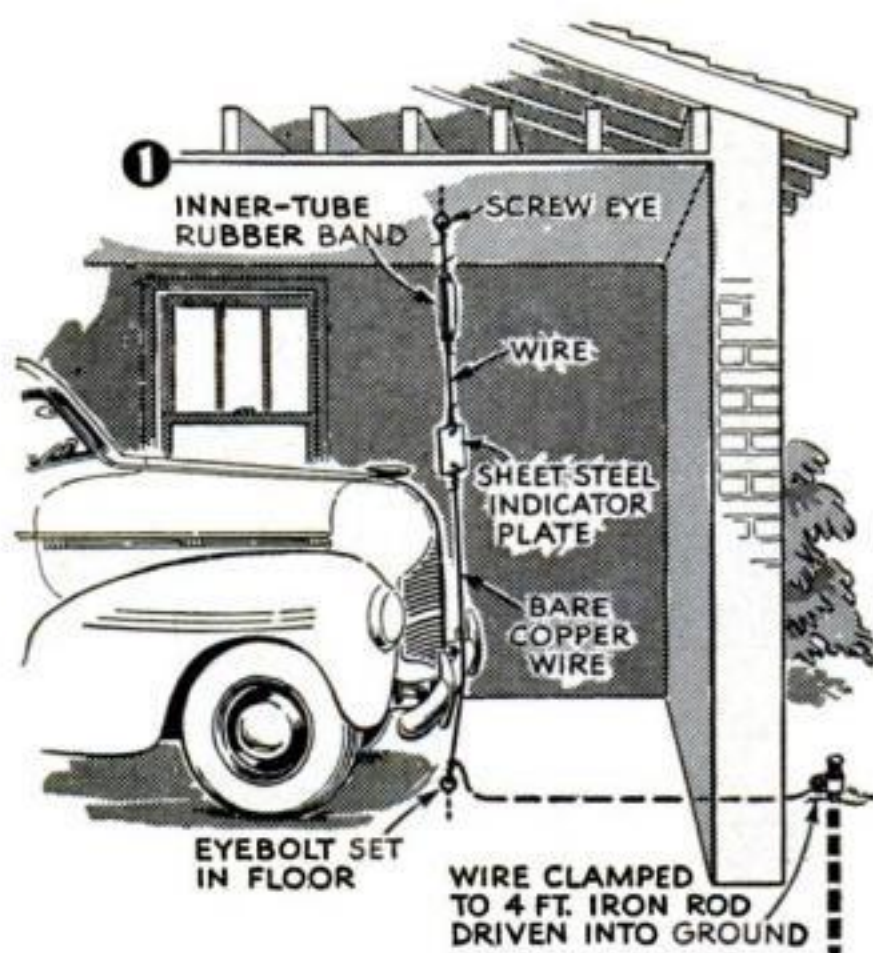
EIGHT TIMESAVERS

1 **ANNOYING CAR STATIC** is grounded by running a bare wire from the garage ceiling through an eyebolt in the floor to a pipe driven four feet into the ground and making contact with the car bumper. Connect a length of inner-tube rubber and a small plate of sheet steel or tin high in the wire for stretch and visibility.—E.G.M.

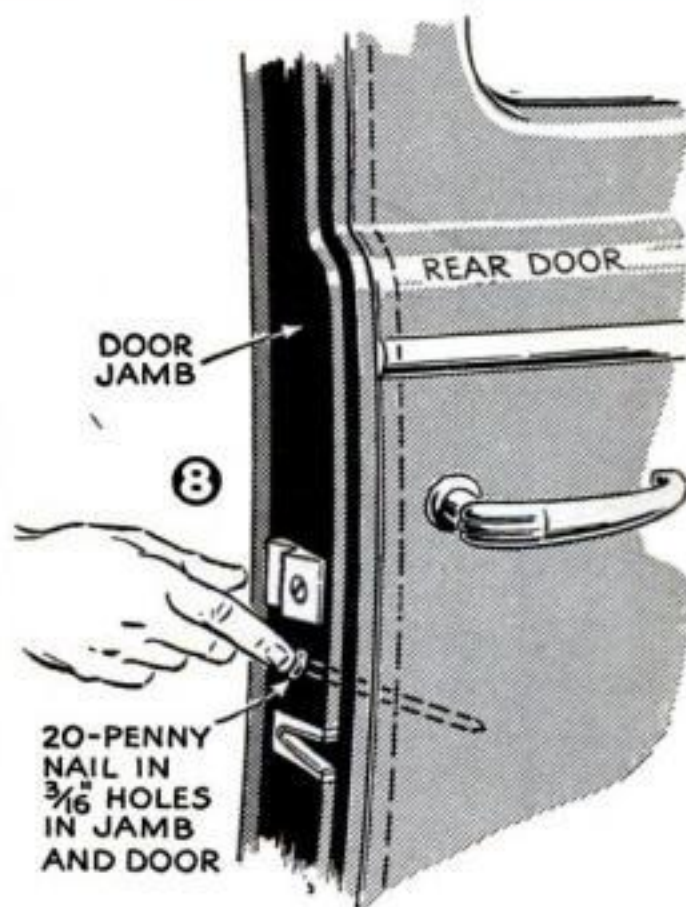
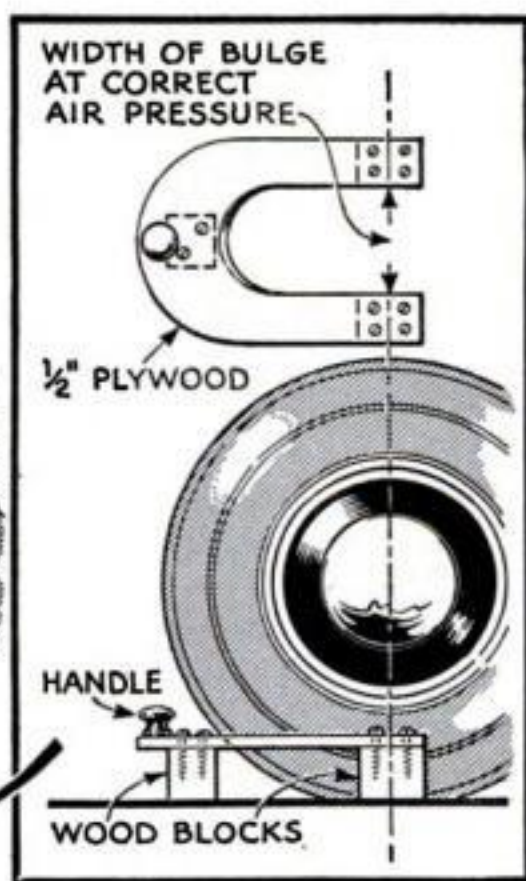
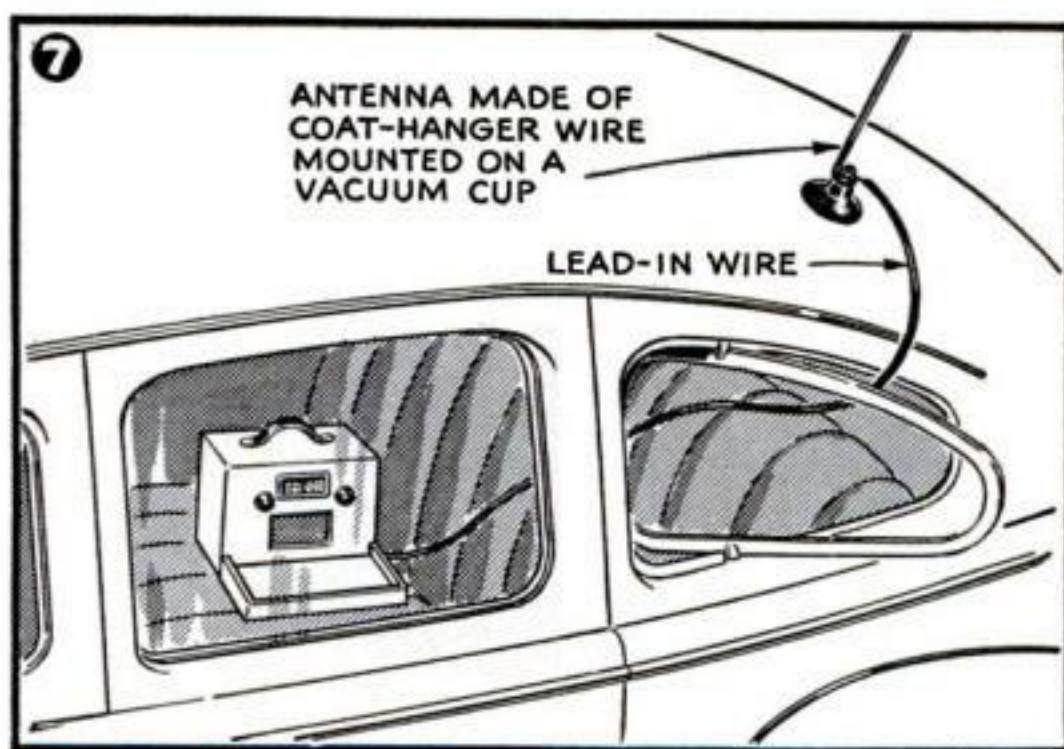
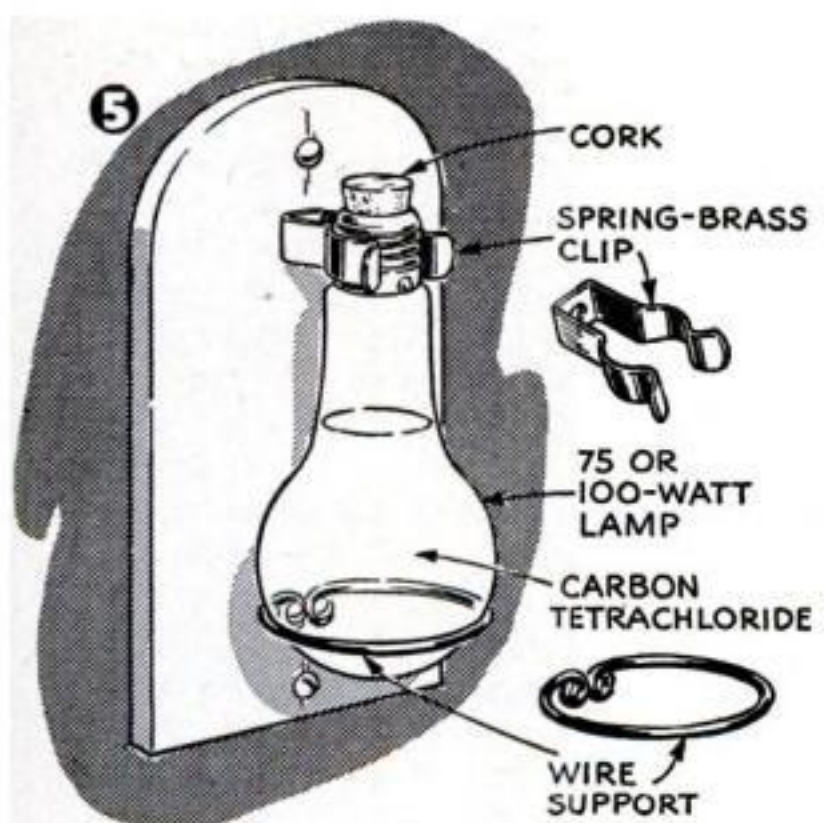
2 **A CAR-WASHING AID**, especially for cars built without running boards, is provided by stringing ropes across the garage ceiling. Standing on a box, you can hold on to a rope with one free hand while cleaning the top.—W.C.W.

3 **MANY USES ARE FOUND** for a shelf that slides in or out beneath the dashboard. Made of three-ply wood sawed to fit the space available, it runs in channels of sheet metal which are bolted to the bottom of the dashboard. Drawn out, it is handy for lunching, writing, or other purposes. A small handle should be attached near the front of the underside.—J.S.

4 **YOUR TIRE JACK** can be slid under the axle more easily by putting it on a block of wood. Drill a hole at an angle to fit the jack handle, and use it to push the block under the car.—C.W.



FOR CAR OWNERS



Drawings by
STEWART ROUSE

5 A FIRE EXTINGUISHER for your car can be made simply out of an old 75 or 100-watt electric light bulb. Saw off the inside of the base and remove the porcelain. Then break the end of the glass bulb in the base and shake out the inside parts. Fill with carbon tetrachloride, leaving space for expansion, seal with a cork, and mount under the dashboard. To use, throw the bulb hard at the center of the flames.—W.A.E.

6 TO TEST TIRE PRESSURE QUICKLY, a simple U-shape gauge cut from plywood to the exact width of your tires when pumped up to recommended pressure will be found useful. Mount the unit on three blocks of wood about three inches in height.—S.R.

7 PORTABLE RADIOS with built-in loop antennas will perform better in metal-roofed cars if used with an antenna which may be shaped as shown from coat-hanger wire and mounted on a vacuum cup outside a rear window. The insulated lead-in wire should be clipped to the antenna contact that deadens reception when touched with a bare finger.—R.E.C.

8 YOUNGSTERS CANNOT OPEN rear car doors with this lock. Drill a hole through the separating door post and into the edge of the rear door. Insert a heavy nail through the post into the door, which is then, in effect, nailed shut, and cannot be opened until the nail is removed.—N.F.W.

Know Your Car's Ignition System

YOU CAN DO YOUR OWN TESTING WITH SIMPLE INSTRUMENTS

NEARLY all ignition testing on your car can be done with instruments which you can assemble yourself in a few hours at a cost of only three or four dollars. However, you must first understand the construction and operation of the various parts of an ignition system—the coil, condenser, distributor, and spark plugs.

The ignition coil is a sort of transformer, which transforms the low voltage of the car battery to a voltage high enough to jump the gap at the spark plugs. It has a straight open core consisting of a bundle of iron wires. Around this is the primary winding, a few turns of relatively heavy wire, the two ends of which are brought out to the two low-tension terminals, usually of the screw type. Around the primary is the secondary winding, thousands of turns of very fine wire. One end of the secondary winding is brought out to the high-tension terminal, usually a socket. The other end is connected to the primary winding, which has the same effect as grounding it.

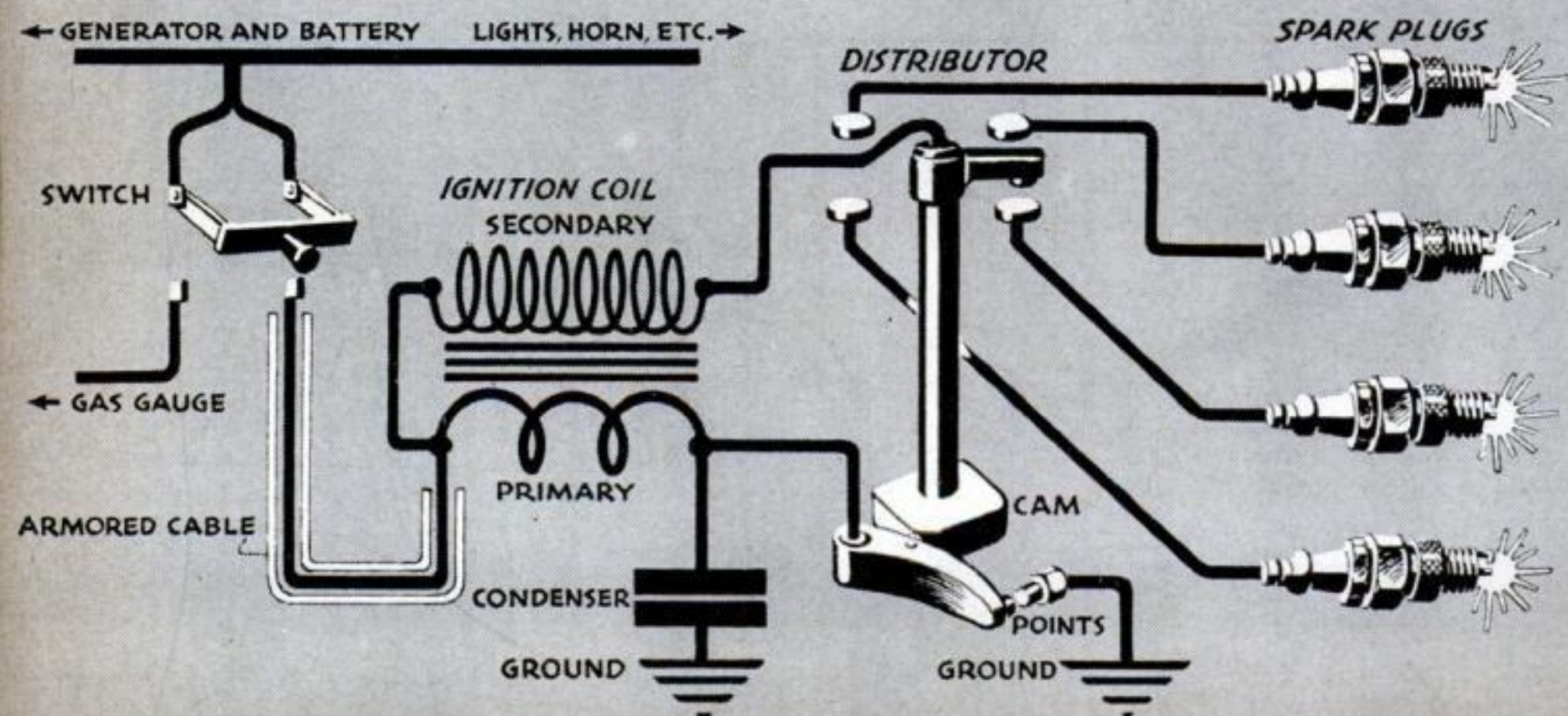
The condenser, usually mounted in or near the distributor, consists of two ribbons of tinfoil, separated by waxed paper, the whole rolled up into a compact bundle and inserted in a small metal can. One piece of tinfoil connects to the flexible wire which comes out of one end of the condenser; the other is grounded to the can.

Electrically, the distributor consists of two entirely separate parts in one case. There is the distributor proper, which distributes the high-tension impulses from the secondary of the coil among the various spark plugs. Below this are the points, which control the current in the primary circuit.

The engine turns the distributor cam, which alternately opens and closes the distributor points. Every time the points close, a current starts to build up in the primary circuit. When the points open, current continues to flow for a very short time, but instead of flowing between the points, it flows through the condenser. When the condenser becomes charged, it stops the flow of current and then discharges, reversing the current flow. This sudden reversal of current in the primary winding induces a very high voltage in the secondary winding. This voltage is directed by the distributor to the spark plug of whichever cylinder is ready to fire.

In making a point-by-point check of an ailing ignition system, first see whether the proper current is flowing in the primary circuit. As long as the points are closed and the ignition switch is on, a current of four or five amperes should flow. This current can be checked by the ammeter on the instrument panel, but a better way is to connect another ammeter into the circuit

This simplified diagram shows the essential parts of an automobile ignition system and what they do



under the hood, where you can watch it while you work. When there is no current or very little current in the primary circuit, the most common reason is that the points are burned or pitted. You can check this by connecting a wire from the low-tension terminal on the side of the distributor to a "ground" on the engine. If the current increases, this indicates that the points have been offering resistance to the current.

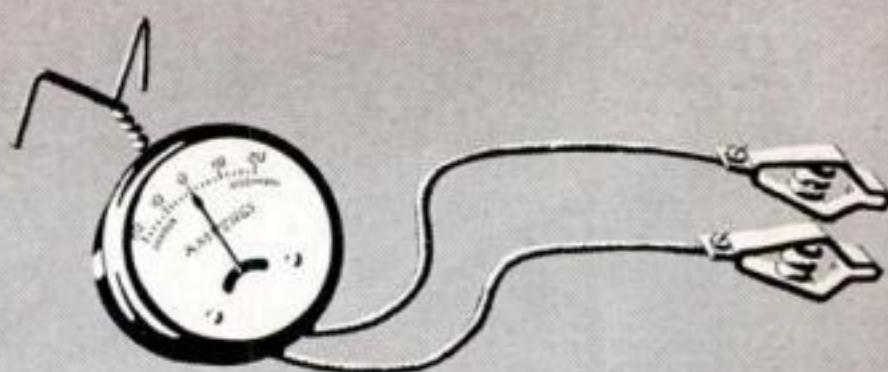
It is also important that the moment of opening of the points be correctly timed, since the spark at the plug occurs when the points open. The manufacturer's timing marks will help you.

There is usually an adjustment for turning the distributor housing to regulate the spark timing. For telling exactly when the points open, a 25-cent timing light is very helpful. This is clipped across the points (one clip to ground, the other to the low-tension terminal on the side of the distributor). The engine is then slowly turned over and the light goes on every time the points open.

If the primary current and timing are correct, the voltage developed by the secondary winding should be checked by inserting in the circuit an adjustable spark gap like the one shown. Disconnect the high-tension cable which runs from the coil to the center of the distributor, preferably the coil end, and connect the adjustable gap in the circuit. Set the points of the gap touching each other and, if possible, start the engine. Then slowly move the points apart until the engine stops. The distance between the points should then be 10 or 12 millimeters. If less than 10 millimeters the coil or condenser is probably at fault.

If the engine will not run, connect the adjustable spark gap directly from the high-tension terminal of the coil to a "ground" on the engine. Remove the distributor cap, turn the engine over until the points close, and then open and close them by hand. As the points open a spark should jump across the gap, if it is set at 10 millimeters or less.

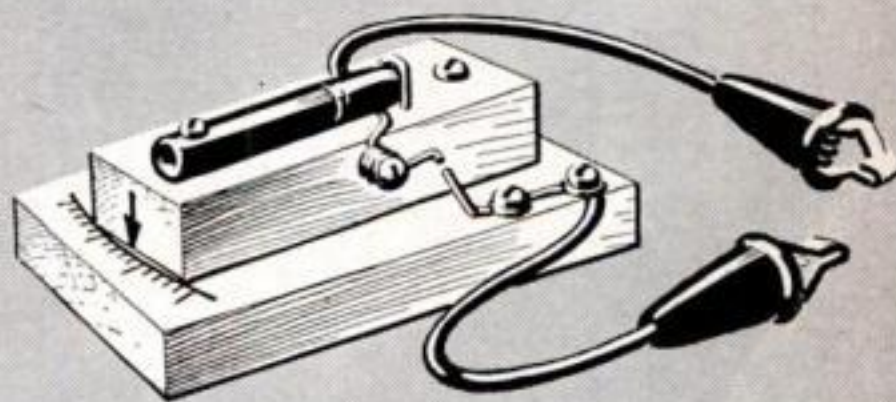
If an ignition system breaks down on the road and you can't find the reason right away, it may be very convenient to have along a coil-condenser set like the one shown. To use it, make sure that the distributor points are in good condition, then disconnect the condenser in the car, turn off the ignition switch to disconnect the coil, connect the three clips of the ignition set as shown in the picture, and move the high-tension lead from the coil in the car to the coil of the ignition set.—DALE KELLY.



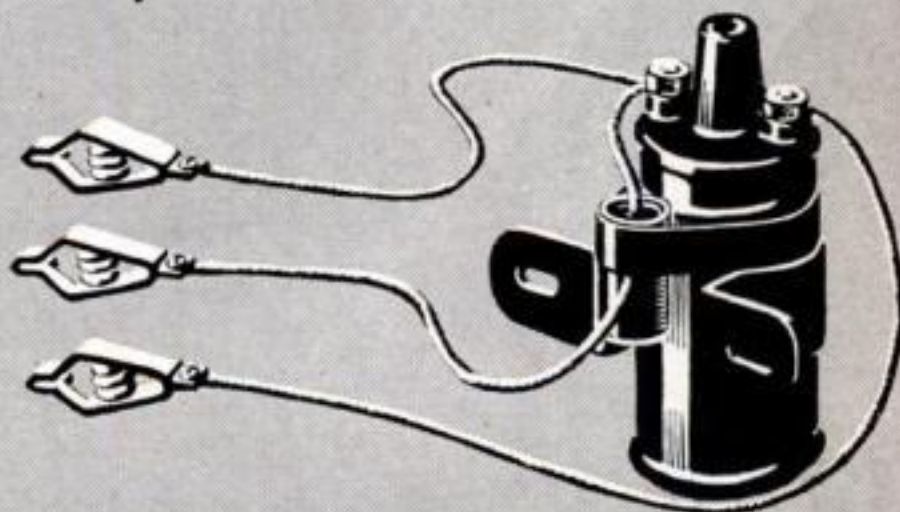
AMMETER. A secondhand one from an old car will be handy for many tests around your car. The hooks are for hanging it on a radiator brace rod under the hood, and the test clips make it easy to connect to any circuit on which you may be working



VOLTMETER. A couple of dollars ought to buy you one of these. It is useful for checking ignition points, generators, lights, and many other parts. The ordinary range of 0 to 7 volts is good enough, but a range of 0 to 10 volts is better



ADJUSTABLE SPARK GAP for checking voltage developed by the secondary winding. Moving the small block varies the gap from 0 to 15 millimeters. The lead from the neon-tube spark-plug tester should be connected toward current source



EMERGENCY IGNITION SET consists of a coil and condenser, taped together and equipped with flexible leads and clips. It's a handy thing to have along if your ignition system goes wrong on the road and you can't find what the trouble is



GUS clears the way

Take it from the Wizard of the Model Garage: Just because your muffler is uncomplaining, don't assume that it's healthy. It may be just suffering in silence!

By MARTIN BUNN

WHEN Gus Wilson got back to the Model Garage after an errand down in the city one day last week, he found Bill, the mechanic, standing still in the middle of the shop floor, scratching his head as he stared at five cars lined up along the far wall. When he saw Gus he grinned. "Too much business, Boss," he said. "They all came in within the last half hour, and I'm darned if I know which one to start on."

Gus fired up his pipe and ran a knowing eye over the lineup. He recognized four of the cars, but the elderly sedan of an expensive make which stood near the door

was a stranger to him. "What's the matter with 'em?" he asked.

"Brakes need adjusting on the Miller job," Bill told him. "Say, that dame drives a car like she was ridin' a bronc' in a rodeo, don't she? Lighting-system check-up on Mr. Knowles's car—he says his headlights black out every time he steps on the dimmer button. Engine won't idle right on Hubbard's bus. That coupe of Dave Sledd's is using a lot too much oil—it might be a bad gasket, hey? I guess maybe I can take care of all of 'em, once I've decided where to make a start."

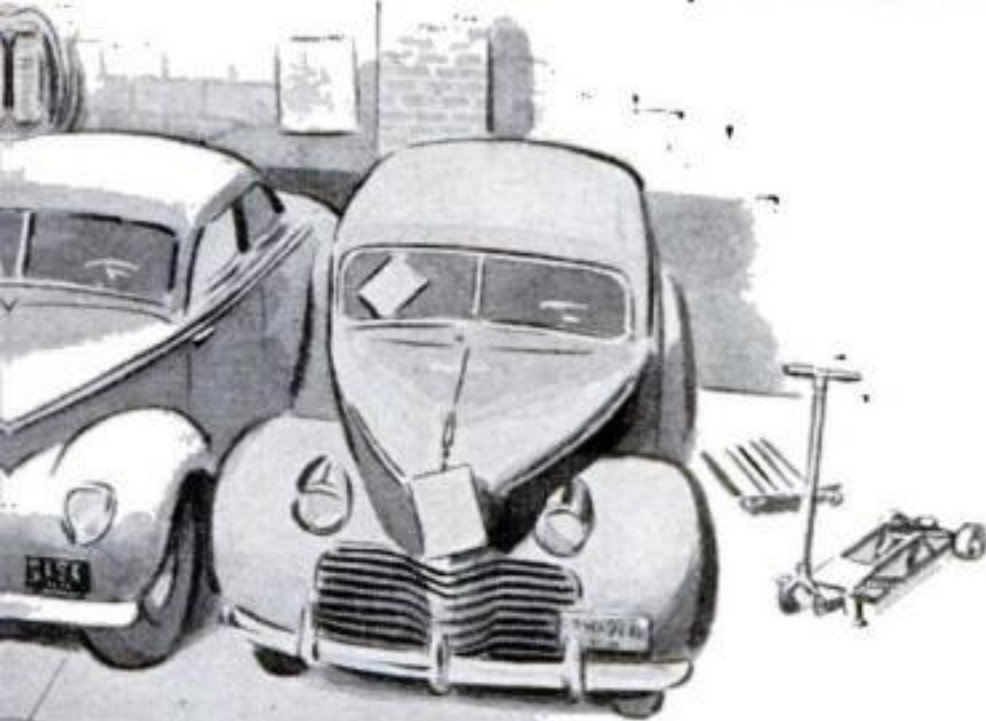
Gus nodded. "What about the other one?" he asked. "Who brought that in?"

"Feller I don't know, but he asked for you," Bill said. "He's in talking to Mr. Clark now."

Gus went into Joe Clark's office and found him in conversation with a scholarly looking middle-aged man who was perched comfortably on the corner of a desk. "Here he is now," Joe said when he saw his partner.

The visitor got off the desk and extended his hand. "My name's Folsom," he said. "Young Dick Coleman is in one of my

Gus fired up his pipe and ran a knowing eye over the lineup. He recognized four of the cars, but the elderly sedan of expensive make which stood near the door was a stranger to him



classes at M.I.T. I was driving through town, and dropped off to say hello to him. I have been having trouble with my car for the last few hundred miles, and when I told him about it he suggested that I come in and see you. It's an old car, but it was a good one, and I never had any real trouble with it until yesterday afternoon. I've had it in three garages along the road, but none of them did it any good. Dick says that you are a champion trouble-shooter, so I thought . . ."

"Dick meant well," Gus said, "but he's put me on a spot. I can imagine myself taking an automotive problem to an M.I.T. professor, but I can't imagine myself solving one for him!"



Folsom laughed. "Possibly that would apply to some of our faculty men, but it doesn't apply to me," he disclaimed. "My subject is mathematics, and I don't know any more than the average car owner—perhaps I know less—about what goes on under the hood. As I was saying, in the three years I've been driving this particular car I've never had any serious trouble until yesterday. Then, without any warning, something happened which keeps it from going over 28 miles an hour. It's just as if there were a governor on the engine."

"Any unusual noise?" Gus wanted to know.

"Yes, there is," Folsom told him. "There's a queer sort of roaring sound that I've never heard before. But I haven't been able to locate its source."

"I'd better take a little ride," Gus decided. "Want to come?"

Folsom said he did. With Gus driving, they set off down the road. The car ran smooth as cream at 25 miles an hour. Then Gus pressed gently down on the accelerator pedal and watched the speedometer hand. It went up to the 28-mile notch—and it didn't go any farther. "By George," Gus said "this is a queer one. You're dead right. The engine acts as if it had a governor on it. Feels queer, too, as if something was holding the car back."

"Hear that noise?" Folsom asked.

Gus nodded. From somewhere under them came a dull roaring sound.

Gus turned the car and drove back to the shop. He got out, leaving the engine running. As he was about to raise the hood Joe Clark stuck his head in at the office door and called that he was wanted on the telephone. "I'll only be a minute," he told Folsom.

When he came back in the shop after answering the 'phone, Gus saw that Folsom still was sitting in the car, and heard that the engine still was running. As he passed the rear end his quick ear caught a faint whistling noise. He cocked his head and listened. It seemed to come from the exhaust pipe.

Black soot came trickling out. "Pretty dirty," Folsom observed. "So that is what has been causing all my trouble."

He held the palm of his hand an inch from the end of the tail pipe. The exhaust seemed normal. But Gus had an idea.

"Step on her, please," he called to Folsom. The engine picked up speed quickly—and then didn't pick up any more speed. The whistling sound grew louder and then deepened into the dull roar they had heard on the road. "Step on her harder," he called to Folsom.

Again Gus held his opened hand close to the end of the tail pipe. This time he didn't feel anything. There was no exhaust!

"Switch her off," he called. "I've got it—although I'm darned if I know just what it is that I've got. There is normal exhaust when your engine is idling, but none at all when you speed it up. What sort of condition is your muffler in, Mr. Folsom?"

Folsom had cut the engine and come around to the back of the car. "Muffler?" he repeated. "Why, I've never had any trouble with it. And, now that you mention it, I've never paid the slightest attention to it."

"Very few drivers ever do," Gus said. "And right there is where they make a big mistake. A car needs exhaust service just as much as it needs any other kind of service. As a matter of fact, the exhaust system deteriorates faster than almost any other part of a car. Most jobs need new mufflers after they've been driven twenty or thirty thousand miles. Why, more than half of the cars that come into this shop need exhaust service—they have dented or leaky or clogged mufflers, or their tail pipes are badly dented or pretty well rusted out, or they have leaky exhaust gaskets. But if you say anything about exhaust service to the average car owner he gets suspicious that you're trying to run up a bill on him. 'Oh,' he says, 'you mean the muffler. Let it go. It'll do all right for a while yet.'"

"Hey, Bill! Help me get the muffler and exhaust pipe off Mr. Folsom's car, will you?" They took the muffler off, and Gus examined it carefully. "Doesn't look too good—rusted almost through." He got a small mallet from his workbench and tapped the muffler gently with it. Black soot came trickling out.

"Pretty dirty," Folsom observed. "So that is what has been causing all my trouble."

Gus shook his head. "No, it can't be that," he said. "It's dirty, but it isn't entirely

clogged up. It isn't so simple as that."

He started to disassemble the muffler. "Hello!" he said. "Here's a baffle plate that's come loose. Let's see, now—by gum, that's it! See what has been happening?"

Folsom examined the muffler and the loose baffle plate. Then he shook his head. "No, I can't say that I do," he admitted.

"Look here," Gus said. He demonstrated as he talked. "While your engine is idling or running at low speed the pressure of the exhaust doesn't amount to much, and this loose baffle plate doesn't do any harm, although the exhaust getting around it makes that whistling sound I spotted when I walked past the rear end of your car while your engine was idling. But when you speed up your engine of course the pressure of the exhaust increases, and when you get up to 28 miles an hour it gets strong enough to press the loose plate against the rear end of the muffler, and hold it over the opening through which the exhaust should escape into the tail pipe. The burned gases which can't get out of the muffler build up a back pressure which acts as a governor on your engine. When you slow down the engine the exhaust pressure eases so that the loose plate isn't held against the end of the muffler and the burned gases can again get around it."

Gus reexamined the muffler. "No use in trying to fix this," he decided. "It's too near done for to make it worth your while. What you need is a new muffler."

"Put it on, please," Folsom said. "And next time you're up Boston way drop in at M.I.T. and give us a lecture on expert automotive trouble-shooting!"

After Folsom had driven away Bill came over to the workbench where Gus was cutting a gasket. "Say, boss," he said, "what's all that stuff I heard you telling that feller about exhaust service? I've cleaned out my share of clogged mufflers in my time, but I never heard anyone call it exhaust service."

"What I call exhaust service," Gus told

him, "is a lot more than just cleaning out a dirty muffler after it has become so clogged that even a dumb driver realizes that there's something wrong with his car. The time to clean out an exhaust system—and, if it needs it, to repair or replace some of its parts—is before it causes any trouble." (Continued on page 218)

GUS SAYS:

I'm telling my customers it's a good time to have their cars put in A-1 shape—while we garage owners still have plenty of help! Next winter it may be tough to get good mechanics to do the work. Sure, it's helping me now, but car owners may thank me later!

HOME AND WORKSHOP



**First-prize winner in our home-planning contest . . . her husband . . .
and the building plot for which she designed her house NEXT PAGE**

Awards in Our

\$1000 CONTEST

"The Home You'd Like to Build"

LISTED below are the 30 winners selected by the jury of awards in the POPULAR SCIENCE \$1,000 house-planning contest.

In both quality and number, the entries far exceeded expectations. There were 3,307 house plans from every state in the Union, the District of Columbia, Alaska, Hawaii, Puerto Rico, and various foreign countries (see P.S.M., Sept. '41, p. 156). The largest number of entries (342) was submitted by readers from the State of New York; next came California with 253, Ohio with 241, Pennsylvania with 238, and Illinois with 203.

Unexpectedly, a young woman carried off

first honors. Still more remarkable is the fact that the first four prize winners live in Illinois, and two of them in the same town. This is a coincidence, since each entry was considered on its intrinsic merits, without regard to personalities, localities, or skill in draftsmanship and literary presentation.

Details of the competition were announced in the issues of February, March, and April, 1941. The jury of awards consisted of three nationally known architects, Ely Jacques Kahn, Cameron Clark, and Frederick J. Woodbridge, together with Charles McLendon, editor-in-chief of POPULAR SCIENCE MONTHLY, and Arthur Wakeling, editor of the Home

and Workshop Department.

In the following article, Henry H. Saylor, who acted as technical adviser on procedure, tells how the jury of awards reached its decisions. Beginning on page 142, Greville Rickard, architectural consultant of POPULAR SCIENCE, gives a general survey of the contest. On pages 146 and 147 is a picture story about the first-prize winner, followed by the plans and specifications of the first-prize house (pages 148-152).

The second-prize house will be described in detail next month, and the third-prize house in the December issue.

FIRST PRIZE, \$500

Mrs. Charles T. Grace, Champaign, Ill.

SECOND PRIZE, \$200

Charles Richard Hogan, Chicago, Ill.

FOURTH PRIZE, \$50

J. P. Callmer, Champaign, Ill.

THIRD PRIZE, \$100

George and Margaret Mallory, Evanston, Ill.

FIFTH PRIZE, \$25

Joseph Sward, San Francisco, Calif.

TWENTY-FIVE PRIZES OF \$5 EACH

Kathleen Wheeler Atterbury, Palo Alto, Calif.

John Bartholomew, Romeo, Mich.

Henry N. Betjemann, Sayville, N. Y.

John Blesch, Fresno, Calif.

Gordon T. Brown, Pittsburgh, Pa.

Paul J. Burns, Elyria, Ohio

William G. Cleland, Jr., Mt. Lebanon, Penn.

Ira E. Cummings, Salt Lake City, Utah

Philip Louis Cuskley, Portland, Me.

Henry H. Davis, Jr., Edmonston, Md.

Dorothy Dow, Rockport, Mass.

Robert G. Fleury, Jr., Brooklyn, N. Y.

Mr. and Mrs. Milosh G. Vuinovich, Jersey City, N. J.

Arthur Greenbaum, Miami, Fla.

Mrs. Henry Keinen, New York, N. Y.

Robert Hugo Klammer, Lincoln, Neb.

John W. Knobel, Ozone Park, N. Y.

Roland K. Kuechle, Columbus, Ohio

William Lohrand, Barberton, Ohio

Mrs. W. P. MacLean, Berwyn, Ill.

Marie and Ralph Nelson, New Rochelle, N. Y.

William J. Newton, El Monte, Calif.

Jock Nichols, San Quentin, Calif.

A. D. Roberts, Alhambra, Calif.

Edythe Heritage Rosenberger, El Cajon, Calif.



The three distinguished American architects who served on the jury of awards. Left to right, Frederick J. Woodbridge, president, Architectural League of New York; Ely Jacques Kahn, and Cameron Clark

How Prize-Winning Homes Were Selected

By HENRY H. SAYLOR, A. I. A.

IN FACING their task of selecting the winners in the house-planning contest, the judges agreed upon several basic facts. The competition differed radically from the usual tests of architectural skill. It called, not for a display of technical knowledge regarding building, but rather for a layman's indication of what he or she wanted in a house—the sort of information a prospective home builder would put together in notes and rough sketches to get his own ideas across to his architect.

In purpose, the contest was to make people visualize their individual home-making needs; it was not intended or expected that they would create an architectural masterpiece.

Particularly surprising, in the judges' observations, was the fact that so many contestants knew something about architectural presentation and its own peculiar vocabulary of graphic forms of expression. Of course, among the three thousand odd entries, there were some from architectural students, interior decorators, engineers, and oth-

ers with some knowledge of mechanical drawing, but the jury was not to be influenced by clever drawing or sophisticated presentation.

When an unusually fine piece of presentation appeared before the jury, it came in for special scrutiny. If it had come from an architect, it would have to be rejected, in accordance with the conditions of the contest. In doubtful cases among the schemes being considered as prize-winning possibilities, *POPULAR SCIENCE* made sure by investigation that the contestant was eligible under the rules.

Naturally, in this great accumulation of layman home-building ideas, there were many of the errors common to the untrained technician, but these were not held against the contestants excepting as they indicated failure to think through the purposes of various rooms, intercommunication, sun, breezes, view, and other obvious necessities of planning. For example, some contestants indicated bedroom layouts in which there was not enough space for beds; others subdivided what would have been adequate dining space into dining room and breakfast

Judging
**HOUSE
CONTEST**

Judging HOUSE CONTEST

nook, neither of which would have served its purpose; another common mistake was the location of living room so completely in the

center of things as to leave it little or no outside light and ventilation.

The intricacies of stair design, as was to be expected, proved too much for a good many contestants, almost always with the result that the necessary space for head-room was sadly underestimated.

Nevertheless, shortcomings of this character were not held against the competitor. He or she was not supposed to have the technical knowledge to avoid them. Minor errors of space provision, intricacies of roof design, proper spacing of window and door openings—these were considered the sort of things that an architect would naturally correct if the scheme proceeded to the stage of actual construction.

Members of the jury kept open minds both as to the use of historic styles or their avoidance. Nevertheless, they looked askance at attempts to put a Dutch Colonial design in Southern California, or a pueblo house on the coast of Maine. There were not a great many submissions of this kind. More frequent were the examples which had been given insufficient thought in planning.

To take a concrete example, we illustrate on the facing page the plan of one prospective home owner's house of dreams. Juror A made this comment: "Here's a scheme that has been carefully planned as to the relationship of its various elements, and the result is a house of which many owners might justly be proud."

Juror B: "True enough, but notice what would happen to his living room; it becomes little better than a thoroughfare. Family or

guests entering, or going into the bedroom end, would have practically to tramp all over a little group of two or three seated around the fireplace."

Juror C: "Yes, I'm afraid that cannot be rated very highly in spite of its other merits. What we are looking for here is an arrangement of space suited to the competitor's individual family needs. This particular one wouldn't work out successfully for his family or for any other. Yet any architect could alter the plan without much difficulty, so let's give the contestant what credit we can for the features that are well designed."

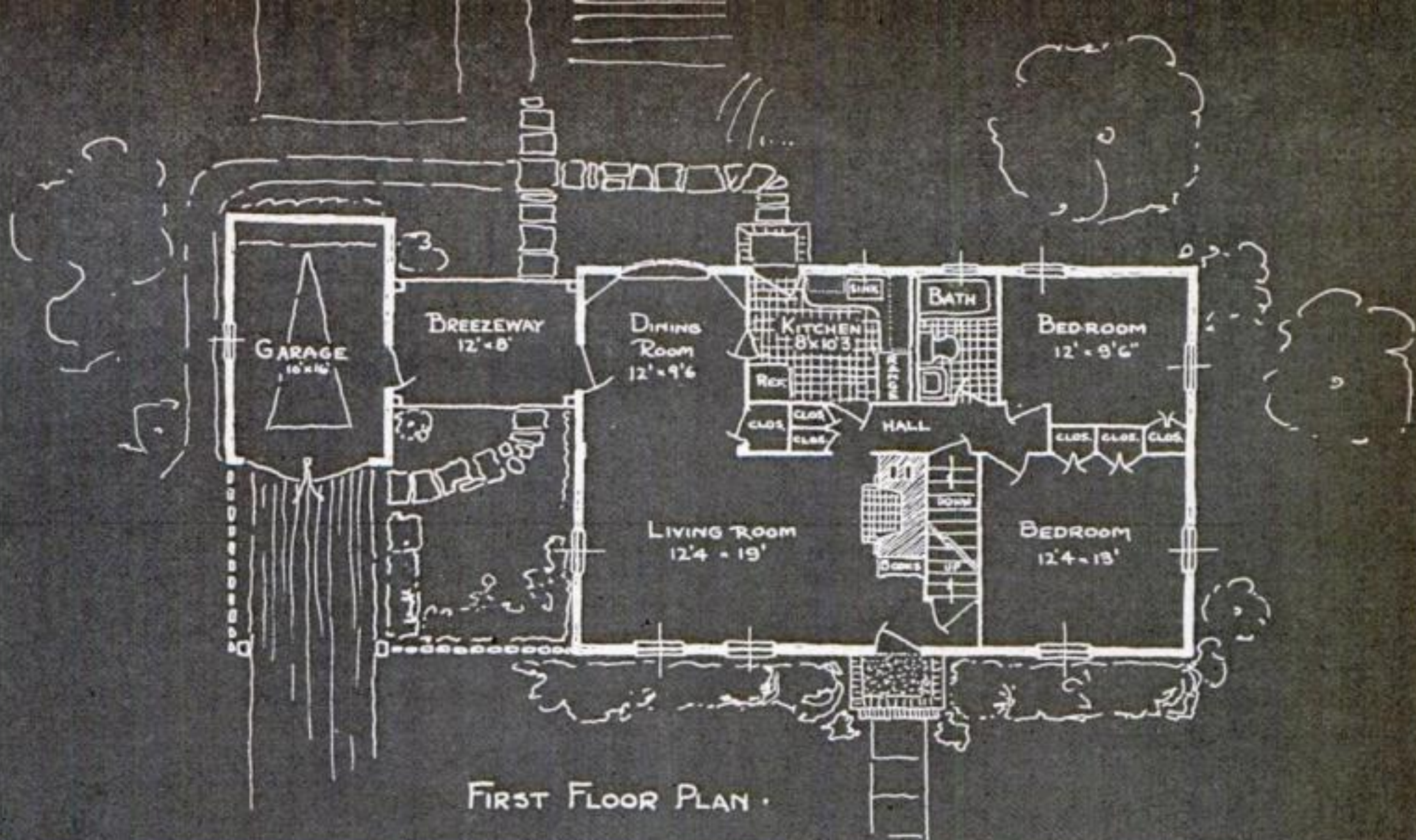
But let us get on to the first-prize scheme, and see what the judges really liked. The floor plan (see page 148) certainly does not fall into any of the widely followed types. Here surely is individuality. There is no suggestion of the central hall type—living room on one side, kitchen and dining room on the other. Nor is there any possibility that the competitor started with a preconceived exterior mass and subdivided it inside to suit. Rather is the plan the logical—almost inevitable—result of fitting space needs and intercommunication to a family's way of living.

Notice how definitely the kitchen has been made the bridge of the ship. This is not a two-maid house, nor a one-maid one, for the housewife proposes to run it herself, and she can run it properly from that bridge. If a visitor approaches, the broad kitchen windows tell whether it be friend or peddler, and it is but a few steps to the front door and a suitable greeting. That kitchen invites the morning sun; it is a pleasant place to work. Its table and seat are for the hurried breakfast, in comfort and convenience rather than formality.

If laundry work is to be done after breakfast, there is the sunlit laboratory for that purpose, also looking out over the wide flow-

For judging, the entries were spread out on tables. The architectural jurors are seated; standing, left to right, are Arthur Wakeling, Greville Rickard, and Charles McLendon, editor of POPULAR SCIENCE





Can you find the defect in this plan? It was submitted as part of a beautifully prepared and highly meritorious entry, but the jurors, as explained by Mr. Saylor, would not consider it for a major prize

er planting of the east front. A ground-floor laundry—comparatively rare these days—always bears witness to the fact that the housewife really knows what she wants, and isn't going to be talked into putting tubs and machine aids into some unused corner of the cellar, just for economy's sake.

The judges liked the way in which dining space has the suggestion of its own particular area, yet shares it for the more frequent needs of the living room. Close by it, beyond folding doors, the terrace beckons to outdoor meals, and these can be served from the kitchen without going through the dining space.

One of the cleverest features of the plan is the space marked "service hall." It really isn't a hall, set aside for transportation only. It is a fully usable part of both kitchen and laundry, and is just the sort of dual-purpose space that architects constantly strive to attain. Notice that by opening all or half of the Dutch door leading to the terrace, cross ventilation is provided for kitchen and laundry.

There are points worthy of notice in every part of this carefully evolved plan. Sleeping quarters are off by themselves, with bath as close to both rooms as it could be without that troublesome expedient of the two-door bath. Here, it also serves as a front hall lavatory for the family or the casual visitor.

One drives into the garage and finds an inside door convenient both to housewife laden with groceries and to the master seeking

his terrace chair after the day's hard work.

See how effectually the fireplace and its seats are organized against traffic. Clever also is the location of the heater room, with its flue passing over the hall ceiling into the single chimney. And in this same heater room is the master's photographic dark-room—so made by pulling a slide across the glass blocks that give it light from the entrance shelter. And another evidence of the home-loving male is the workbench in the garage.

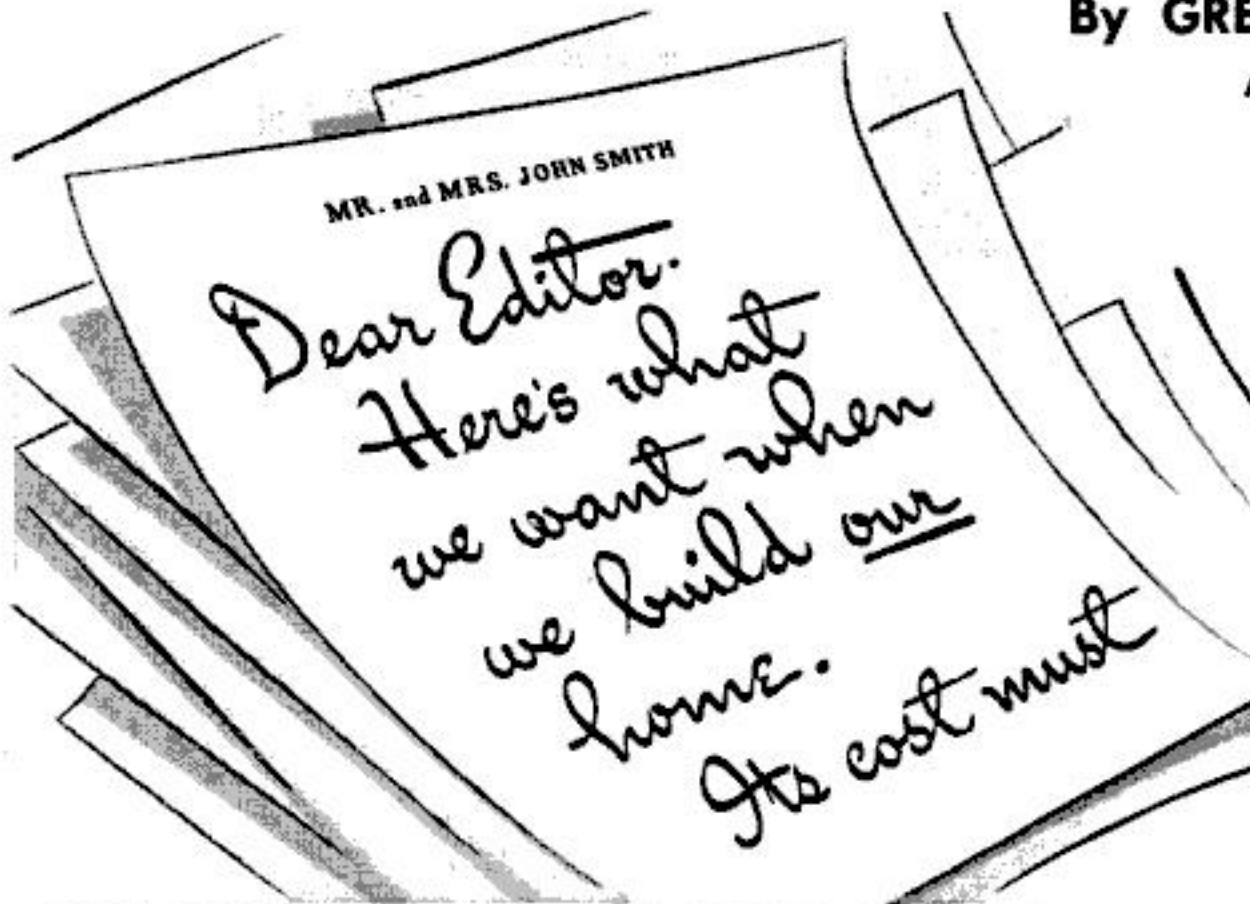
Guest room also joins the dual-purpose ranks in serving as a study and writing room. Notice that the bedroom closets have not only the properly proportioned space for hanging clothing, but also a tier of drawers.

Just because this prize-winning plan is so good for the family of two that will use it, just so should it be carefully examined before some other family, with differing needs and habits of life, adopts it as a pattern to be blindly followed. It will not serve all needs. Others might find it more expedient to practice the economy of putting bedrooms and bath on a second floor, or a sloping site might call for a basement garage.

Next month, and in the issues to follow, other prize winners will be shown and analyzed. No two are even faintly alike; each is the answer to a prospective owner's individual needs and desires. Careful study of these results should be an ideal way of setting in order the reader's own ideas of what he wants in a house, and why.

By GREVILLE RICKARD, A.I.A.

Architectural Consultant of
Popular Science Monthly



AN ANALYSIS OF CONTEST ENTRIES

PERHAPS no other occasion has presented itself quite like that afforded by the home-planning competition of POPULAR SCIENCE by which we are able to visualize what the average person wants when he sets out to build a house.

Architects have definite ideas, based on countless technical studies, as to what constitutes a desirable house for the average family. Speculative builders, on their part, have never left us in doubt as to the sort of house they believe can be sold with the greatest ease and profit to Mr. and Mrs. John Smith. Now, however, Mr. and Mrs. John Smith have come out and spoken for themselves. They really know what they want!

By taking a cross section of the 3,307 entries, we have been able to analyze in great detail the preferences of the contestants. What stands out most conspicuously is the high standard of living represented by this readership. The families have comparatively good incomes; they have children; they want well-built, substantial houses; they insist upon modern equipment and conveniences. This is all the more pointed because the contest rules purposely limited the cost of the house to \$10,000 maximum, thus eliminating any consideration of expensive residences and incomes in the higher brackets.

Here are the trends revealed by our study of the entries:

1. A preference for bungalows. Out of every twenty-three contestants, ten say they want a one-story bungalow, five favor a story-and-a-half house of bungalow style, and eight want a

two-story house. It follows, therefore, that a large number of the designs are of a spread-out rather than of a compact type.

2. Colonial styles are in the majority. These include formal Colonial, Cape Cod (not always too pure), and a rambling or country Colonial.

3. The houses are necessarily small. Sixteen percent of the plans are for a man and his wife; 27 percent are for a family of three; 35 percent for a

family of four; 15 percent for five, and 7 percent for six.

4. The cost of the majority of the houses, as estimated by the contestants, ranges from \$5,000 to \$8,000, exclusive of land.

5. The sizes fall for the most part between 15,000 and 24,000 cubic feet.

6. The average number of rooms is five, which means living room, dining room, kitchen, and two bedrooms.

7. Living rooms, in their shapes, vary as much as the houses. They do, however, show certain tendencies. Though variable in sizes, we find the average to be 14' 5" wide by 21' 8" long. This indicates a preference for the rectangle, but illustrates, too, an interesting point. An oft-taught theory has it that an agreeably shaped rectangle or room is one in which its length is $1\frac{1}{2}$ times its width. Observe how closely this coincides with our tabulation: $14' 5" \text{ plus } 7' 2\frac{1}{2}" = 21' 7\frac{1}{2}"$ (almost 21' 8"). Living rooms often include dining areas at one end or tucked aside in the wing of an L. Windows are numerous and of all types—narrow and wide, extended into bays, sometimes taking in the side of a room and running around the corner. The fireplace is practically a "must" feature.

8. The average size of the kitchen turns out to be 9' 8" by 13' 2", indicating here, too, a preference for the rectangle, which is well recognized to be step-saving and easy of circulation. Much good planning has gone into these kitchens, and the latest in convenient and serviceable equipment has been provided. This generally includes a double sink, cabinets, gas range or electric range, re-

Ideas from
**HOUSE
CONTEST**

frigerator, and automatic hot-water supply.

9. The most modern equipment throughout has, in fact, been insisted upon by almost all contestants. In the heating of the house, one out of every seven contestants desires air-conditioning (what is often called enforced hot air). Almost as many wish to have hot air. A great many do not specify the type of heating plant, but apparently intend to use either steam or hot water. As to fuel, one out of four desires oil, and one out of slightly more than five prefers gas. Coal is mentioned in about the same ratio as gas, and one in every seventeen calls for an automatic stoker.

10. In the department of plumbing, for every three who specify brass for water piping, six name copper, and five galvanized iron.

11. Waterproofing in cellar walls has been specified by one in every eight; and out of every five, two intend to have insulation in their outer walls and roof. Rock-wool batts and insulating board are the types of insulation most frequently named.

12. As to outside walls, they are generally of familiar materials. Clapboards take a popular lead, being called for more than three times as often as any other type.

Then come brick veneer, shingles, and stucco in about equal amounts; next, concrete blocks (sometimes stuccoed), and vertical siding, this often being mixed with brick or clapboards; then, in lesser demand, stone, and more rarely, plywood. Glass blocks are used only at times for sections of wall, but one in seven mentions them for some purpose—a remarkable indication of their growing popularity.

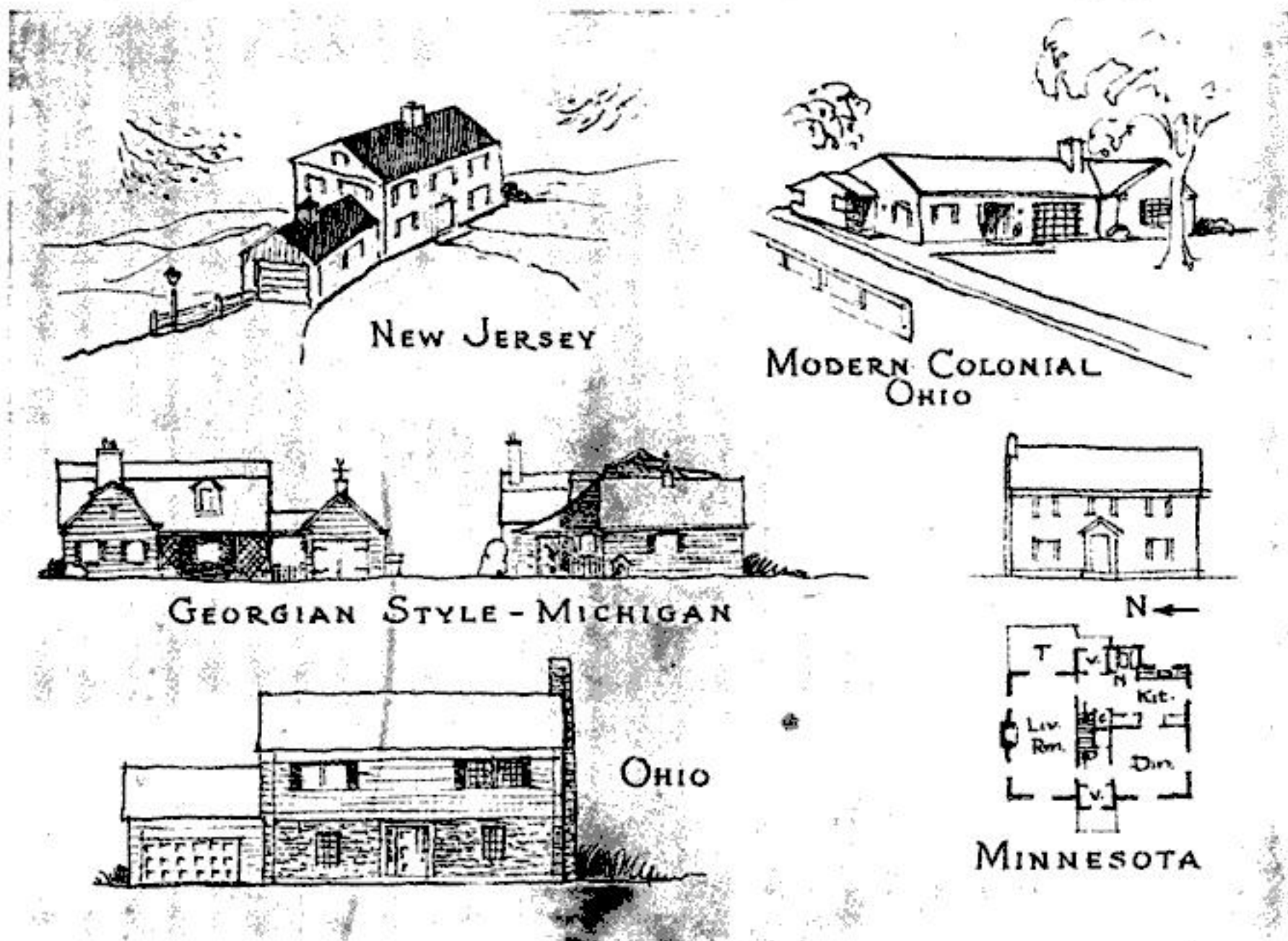
13. As covering for roofs, wooden shingles are in the lead. Almost a third ask for shingles, a fourth for slate, an eighth for asphalt, and the remainder for composition, asbestos, and tile.

So much for the high lights of the contest! When it comes to details of site, family, character of house, and its plan arrangement, our facts divide themselves naturally under the following headings:

Building sites. Indications are that most of the contestants intend to build in towns and suburbs on lots of definite size, though a few obviously have country property in mind.

Cost. The maximum cost of building the house, as specified in the rules, was \$10,000. In at least two instances a contestant who might well have won a prize was disqualified

COLONIAL-STYLE HOMES stand first in popularity. The thumb-nail sketches below illustrate basic elements of five designs submitted by contestants who live in the states noted. These vivid little drawings, as well as those on the next two pages, were made by Mr. Rickard while analyzing the entries



Ideas from HOUSE CONTEST

because his design, if built, would be found to cost more than \$10,000, as the judges discovered when they checked the cubage. An architect is apt to suspect that not a few of the contestants, when the time comes to build, will have to increase their budget or forego some of the expensive equipment they have specified.

Family income. Related to costs, of course, are incomes. Thirty percent of the contestants say they have incomes under \$2,000; 38 percent from \$2,000 to \$3,000; 26 percent from \$3,000 to \$5,000; and 6 percent from \$5,000 to \$10,000.

Architectural styles. Here an amazing diversity of taste is revealed. The flat-roofed, or so-called "modern" style, however, is not generally popular. Only one in fifteen falls in that category. Most of these, too, prove to be less functional, that is, to have more impractical features of planning, if anything, than designs of other types. Details of modern trend, nevertheless, do appear in some designs of traditional background; for example, long horizontal window panes, or corner windows, in what might ordinarily be termed a Colonial house.

The diversity in styles defies tabulation, and the crossing of these trends invites the frequent use of the hyphen. As pointed out, the Colonial style is well in the lead. A number of designs are well spread out, and among these a favorite feature is the covered passageway leading from garage to house.

Extremely popular is what may be termed the "Cape Cod" type of house, with, however, two front dormers, and a lean-to dormer behind, adding space to the second floor.

The obvious subterfuge of this building trick is always disliked by architects, it being obvious that the skimpy strip of roof at the gable end tells a false story as to the actual shape of the house.

One conclusion to be drawn is that most contestants, even among the first 100, would be well repaid in seeking the advice of an architect before building. They might thus save themselves from making serious mistakes. (Some of these mistakes, by the way, will be discussed in a future article.) Architectural advice would safeguard them against the innumerable hazards of building and protect their investments by insuring them of full value for every dollar spent.

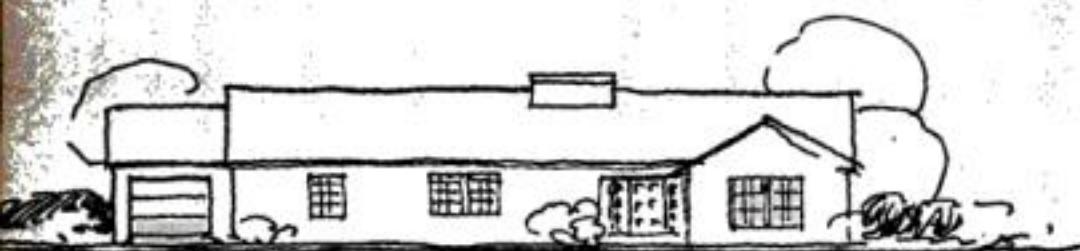
Floor plans. As a rule the plans are superior to the exterior designs. In a broad sense, they are generally sound. Again and again we enter, directly or indirectly, a long living room, and see a dining room or dining space off to one side or behind. Beyond that is the kitchen; then to the other side of the house, connected by a passage, are two bedrooms with bathroom between. Occasionally there are three bedrooms. Sometimes there are two or three bedrooms upstairs, or provision for future rooms is made. Out of every nineteen contestants, twelve want two bedrooms, six require three, while one would like four.

Surprisingly, many reveal a willingness to forego the convenience of an entrance hall with coat closet nearby.



Cape Cod houses are often distorted with a large rear dormer—bad because the gable end is deceptive in shape

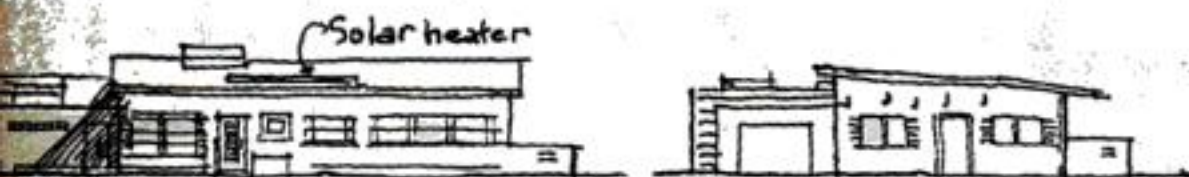
MODERN DESIGNS were in the minority; nevertheless almost every variety was represented. Here are a few from various states. The one from Michigan has considerable merit, but could not be built for \$10,000, the contest maximum. Strange to say, some modern designs were far from being functional



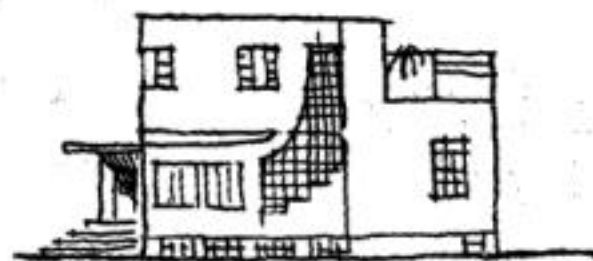
NEBRASKA



MICHIGAN (TOO COSTLY)



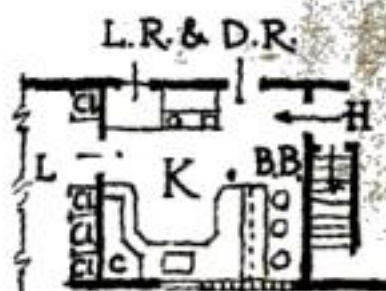
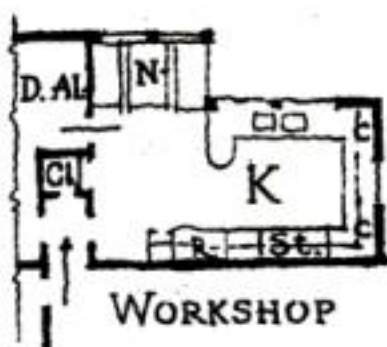
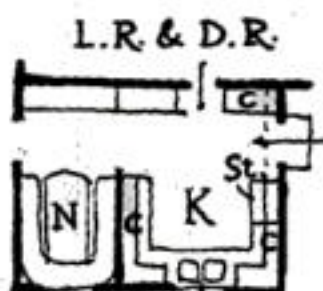
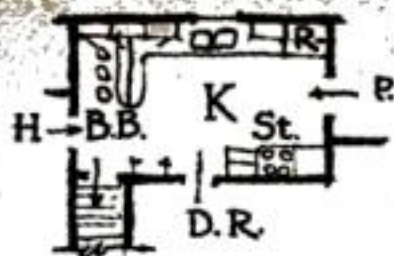
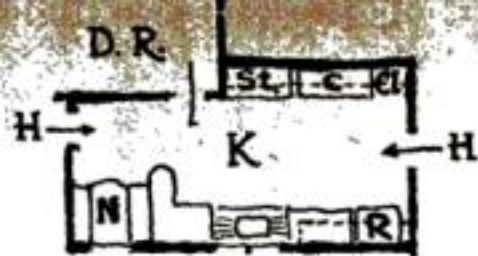
FLORIDA



MISSOURI



TENNESSEE



SEVEN TYPES OF KITCHENS picked at random from contestants' plans. The abbreviations used are as follows: B.B., breakfast bar; C, cabinet; Cl., closet; D.Al., dining alcove; D.R., dining room; H, hall; K, kitchen; L, laundry; L.R., living room; N, dining nook; P, porch; R, refrigerator; St., stove

In making a choice between a separate dining room and dining space in the living room, the contestants are divided almost evenly. Out of every twenty-one plans, ten contain a dining room, nine provide only for dining space, and two compromise with a dining alcove. The breakfast nook is a generally desired feature and, of course, is included in many of the plans, generally at one end of the kitchen.

The rambling western house often has no cellar, and so the laundry is placed on the first floor. In houses with cellars, the laundry room is usually in the basement. The ratio of upstairs laundries to downstairs laundries is as 19 to 27.

Large cellars usually include workshops, darkrooms, and game rooms, while in cellarless houses some of these features are included in the ground-floor plan, the workbench often being tucked into the garage. Some have called the workroom a "hobby lobby." Thirty-nine percent of the contestants call for built-in workshops, 7 percent for built-in darkrooms, and 11 percent defi-

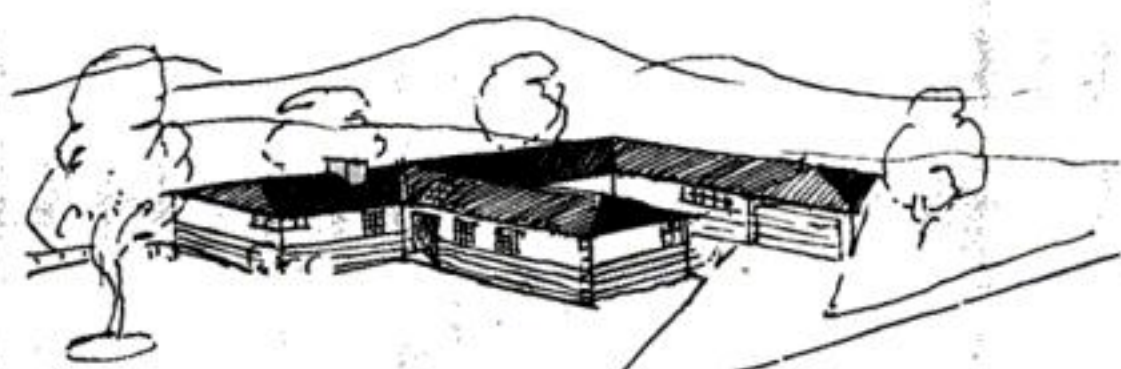
nately plan to have a space for a sewing machine.

The second floor is sometimes given added importance by the inclusion of a living room, a game room, or a "rumpus retreat." One woman aptly designated a second-floor space in a wing as the "get-away-from-it-all room."

A porch on the second floor is surprisingly neglected, in view of its popularity in recent years. Plans of a distinctively modern type, however, make much of the second-floor terrace, separated only by glass from bedrooms behind.

This discussion of the many phases of a house could go on without end into its minor details, but space does not permit. It is to be hoped, however, that the picture given in the foregoing paragraphs may be useful to the home-building reader in knowing something of what the other fellow desires in his home. May he find as much satisfaction in building as many of the contestants acknowledge they have experienced in working out their plans!

MISCELLANEOUS DESIGNS of all kinds were submitted. In one classification were what may be called "picturesque" houses. Another group consisted of low, rambling Western designs and ranch houses. A few Spanish and Italian styles came from Florida and elsewhere, and there were many good cottages



RANCH HOUSE
CALIFORNIA



ENGLISH PICTURESQUE-CONN.



SPANISH MODERN-PENNA.



RAMBLING SPANISH-FLORIDA



Mrs. Grace spreads out a number of her preliminary studies. On some days she kept at her task for ten hours—four in the morning, four in the afternoon, and two more at night

First-Prize Winner

REWORKED HER DESIGN FIFTEEN TIMES

MRS. CHARLES T. GRACE, of Champaign, Ill., winner of first prize in our house-planning contest, is the 23-year-old wife of a mechanical-engineering instructor at the University of Illinois.

On the day the February issue of the

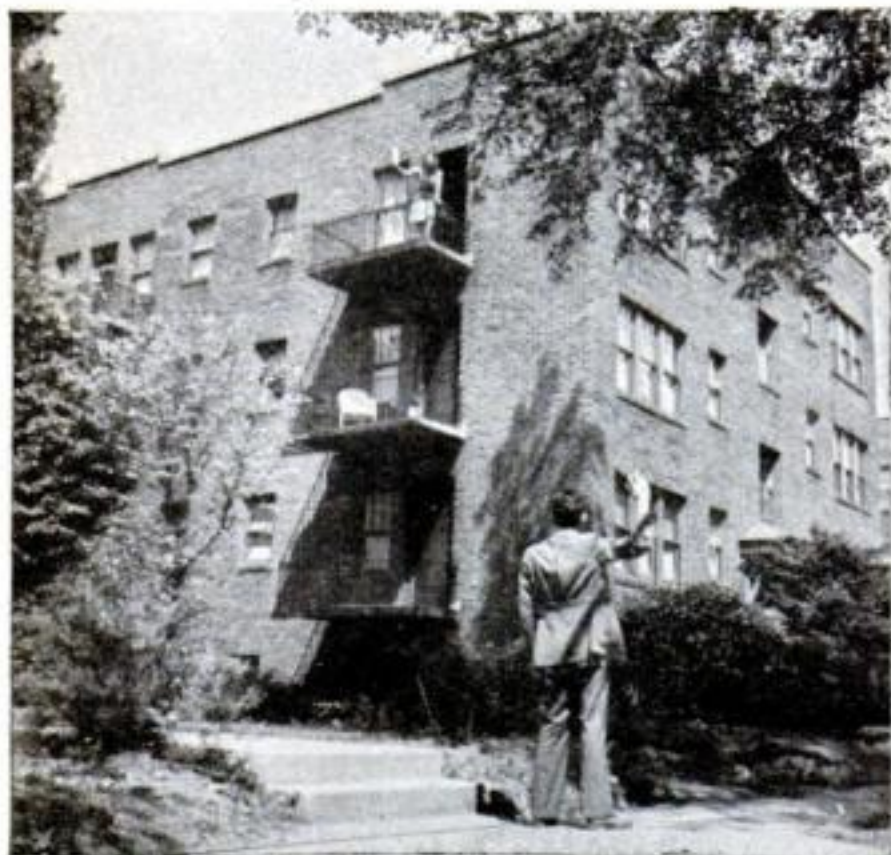
The winner waves the prize notification to tell her husband the good news as he returns from work

magazine appeared with the announcement of the contest, her husband called her attention to it. During the next two months, Mrs. Grace spent more than 150 hours developing her design. She discarded half a dozen plans, and reworked the final one fifteen times. Seated at a card table in one corner of the living room, she sketched the original drawings on scratch paper and inked in the finished drawings on Bristol board.

The house plan she entered in the contest was specially design-

ed for a 100' by 150' lot on the outskirts of Champaign. White brick was chosen for the exterior because brick is widely used in her native state, Colorado, and because there were a number of brick dwellings in the neighborhood of the chosen lot.

The living room in their "one-and-three-quarter room" apartment, for which they pay \$45 a month



The easiest part was dining room and living room. The hardest proved to be the bedrooms. A camera range finder, which Mrs. Grace gave her husband for Christmas, proved of help in judging distances.

In the design of the house, her husband had only two "must" suggestions. He wanted a home-workshop bench in the garage and a darkroom near the furnace. Photography and inventing things are his hobbies.

Mrs. Grace was born in Denver, Colo. In high school and at the University of Colorado, which both she and her husband attended, she specialized in mathematics and engineer-

ing. While other girls were taking courses in cooking and dressmaking, she was studying plumbing, civil engineering, and steel construction. After her marriage in 1937, she completed work for a B. S. degree in architectural engineering at the University of Illinois. In many of her courses, she was the only girl in class. High marks made her a member of the Phi Kappa Phi honorary society. During her last semester, she received one of the Plym prizes for her work in steel construction and design.

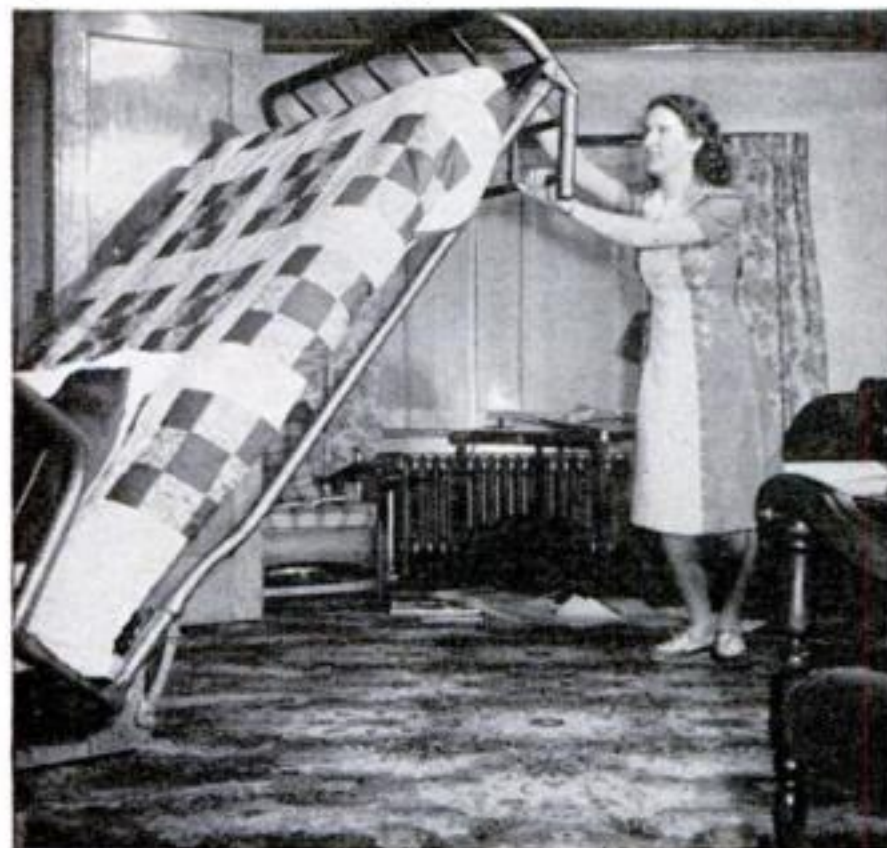
At present, the best bet as to what the Graces will do with the prize money is: Buy the \$500 lot for which the house was designed.

Winner HOUSE CONTEST



Off for the bowling alleys. Mrs. Grace bowls for sport and exercise. Her score is around 120

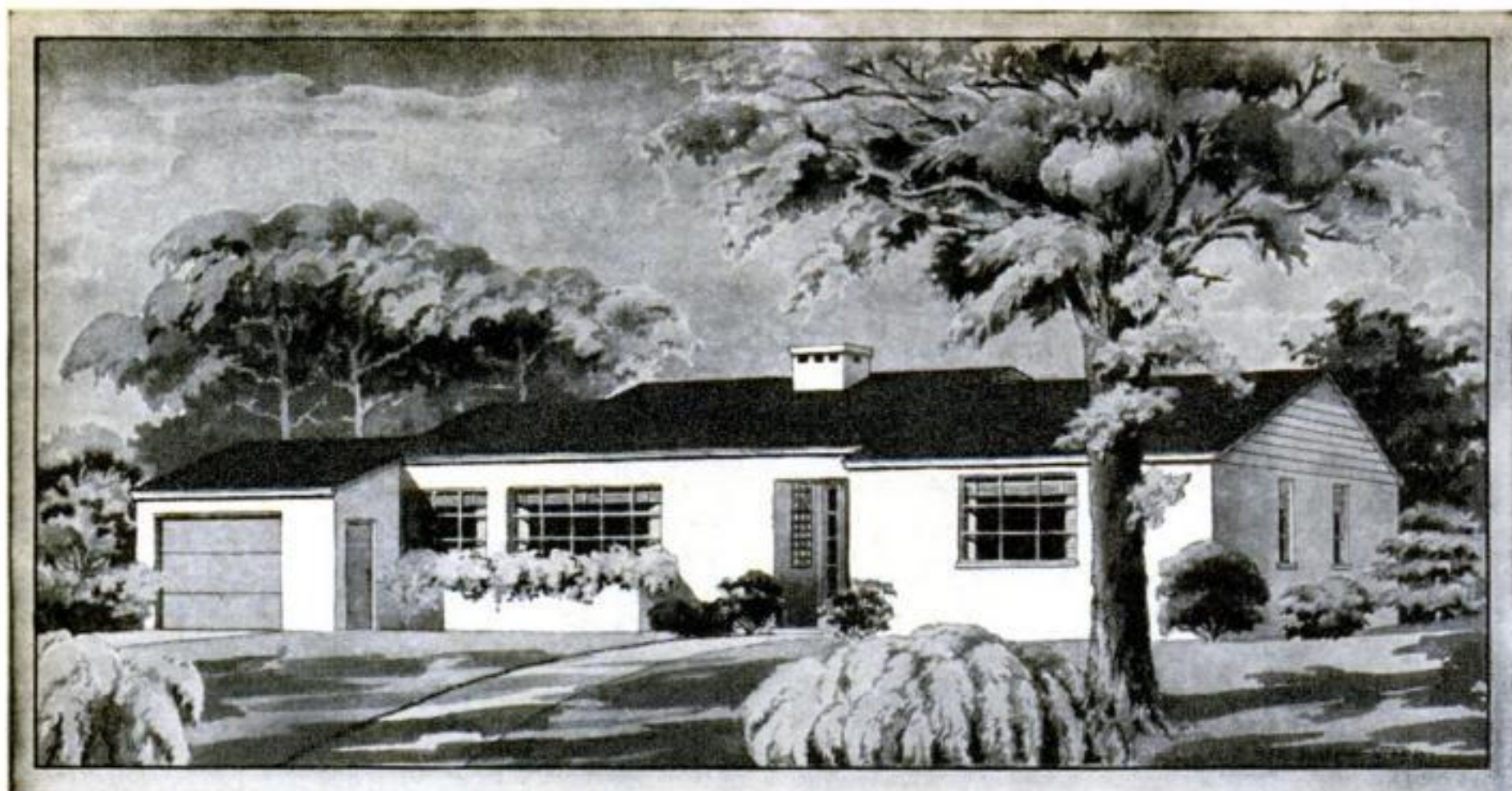
When bedtime arrives, the trick bed in the Graces' apartment makes its appearance in the living room



Her present kitchen isn't bad, but compare it with the one she will have in her new home (next page)

To estimate distance, Mrs. Grace used a camera range finder she gave her husband last Christmas





Planned for a 100' by 150' plot, Mrs. Grace's house is low and of irregular shape. Its maximum outside dimensions are 35' by 62'. The walls are of common brick, painted white; the roofing is blue asphalt



A study of this simplified floor plan reveals the extraordinary skill with which Mrs. Grace designed the house to suit the needs of her husband and herself and to take full advantage of the building plot. Note, for example, that any part of the house may be reached from the front entrance without passing through any other rooms. Mrs. Grace believes optimistically that the house could be built for \$5,950, but an estimate on the basis of 35 cents a cubic foot places the cost nearer \$7,000

FIRST-PRIZE HOME

Here is Mrs. Charles T. Grace's own description of her exceptionally convenient and economical one-floor house plan

THIS is the home we'd like to build. We've planned and replanned every feature and requirement until both my husband and I feel we've settled on just what we want and need.

The lot we'd like to build our house on is at the edge of town with a view of fields and farms sloping away to the west and southwest. The lot itself, 100' by 150', would cost from \$500 to \$750. The maximum outside dimensions of the house are 35' by 62'. We figure the house would cost \$5,950. That would make the total price of house and lot roughly \$6,450 to \$6,700, or within the range of about three times our yearly income.

We think that our plan has many advantages. It's small, just right for the two of us, and yet we'd never be overcrowded when we had company.

The house may be entered directly from the garage through the service hall for bringing in supplies, or by the front-door path.

The plan is economical. There is no waste hall space, the service hall being really a part of the kitchen and laundry room, yet not interfering with the circulation in those areas.

Any part of our house may be reached from the front entrance hall without going through any other rooms. The front door is near the kitchen to save steps in answering the bell.

Our large bedroom is ample in size for lounging as well as sleeping. It gains privacy by being at the back of the house and at the same time takes advantage of the view of open sunlit fields to the west. The spare bedroom or study could be adapted to a larger family. And there is plenty of closet and storage space.

The living areas take full advantage of the view to the west and southwest, and the outdoor terrace can be easily served from the kitchen if we should want to eat there. This terrace really makes our living and dining area seem part of the outdoors, as do the built-in planting boxes under kitchen and bedroom windows. We can follow the sun with our

meals. The breakfast table in the kitchen has the morning sun. The dining room is easily furnished without seeming overcrowded.

The bath is accessible from all parts of the house, yet is separate from the living and dining areas.

The heater room is centrally located, making possible economic heating of all the rooms (garage included) from two main ducts with one branch from each. Yes, every room has cross ventilation—something not always found in one-floor houses.

Moreover, our house would fit in with other houses in the neighborhood as well as with the landscape. We feel that it is modern without seeming cold and ugly.

We have definite requirements of construction:

Exterior walls. Common brick veneer painted white; 2" by 4" studs; sheathing; 1" air space; rock wool, foil-backed insulation; gypsum-cork wall board as an inside painting surface. The use of this wall board eliminates the necessity of waiting for plaster to dry before decorating, adds fire resistance to walls, and won't crack or flake like plaster. The brick planting boxes are built in with the walls. Glass-brick panels in heater and bath as shown on plan.

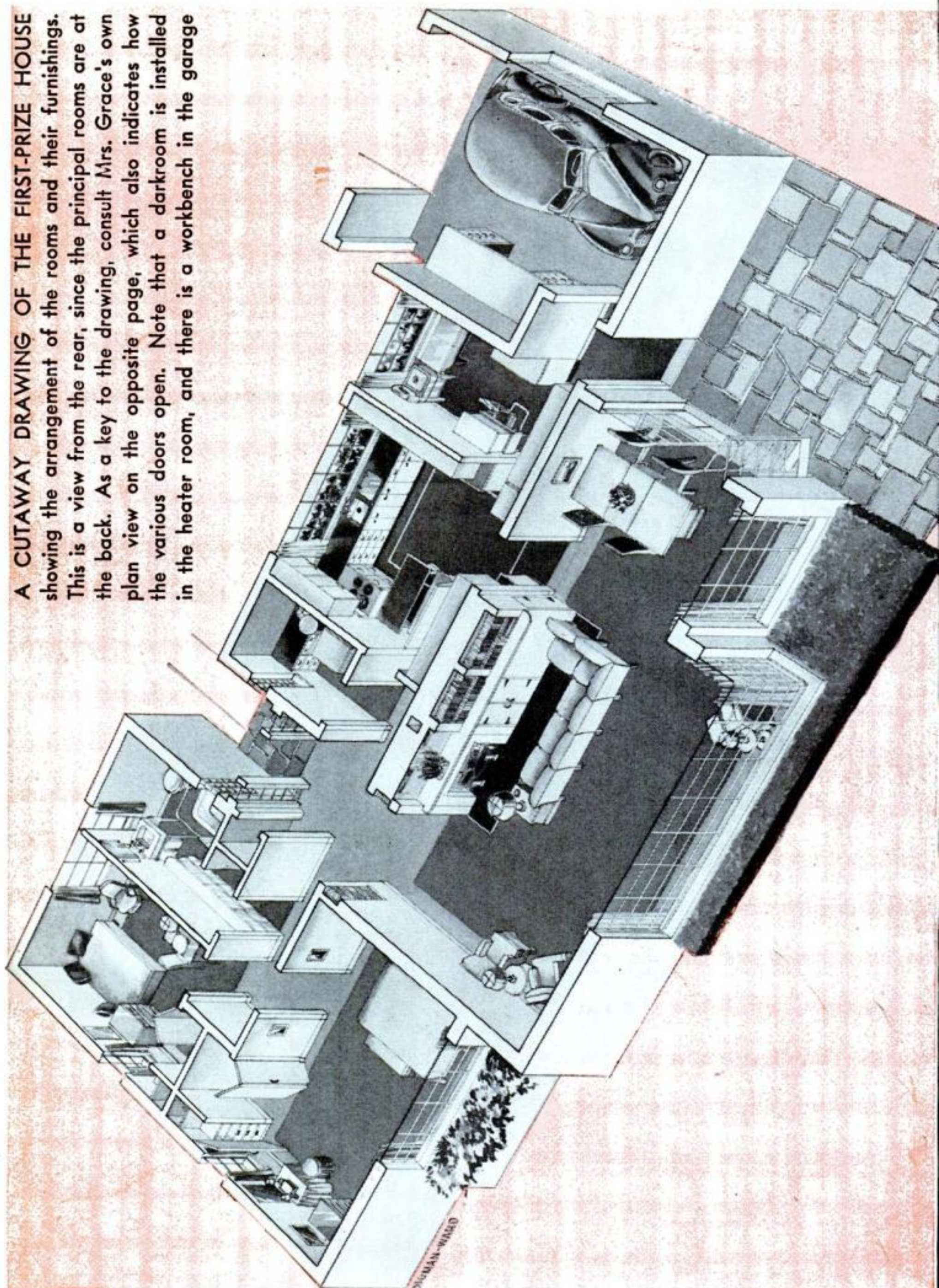
Foundation and floors. A concrete slab laid on cinders forms the foundation for cork-tile flooring of a rich brown coloring in the living areas and for linoleum in the work areas. The cork-tile flooring in living room, dining area, bedrooms, and hall is resilient, quiet, nonslip, clean, a low conductor, and slow burning as an added fire-resistant quality. Bright-colored linoleum in kitchen, laundry, and bath has similar qualities, but may be replaced for changing color schemes. The heater room and garage have plain concrete floors to lessen fire hazards; and the terrace and porch are flagstone.

Interior walls. Studs 2" by 4" with very light pastel-painted wall-board surface. Kitchen has linoleum on work surfaces and above sink to bottom of window. Bath is papered with waterproof paper except for wall

Winning Home

**HOUSE
CONTEST**

A CUTAWAY DRAWING OF THE FIRST-PRIZE HOUSE showing the arrangement of the rooms and their furnishings. This is a view from the rear, since the principal rooms are at the back. As a key to the drawing, consult Mrs. Grace's own plan view on the opposite page, which also indicates how the various doors open. Note that a darkroom is installed in the heater room, and there is a workbench in the garage



board with horizontal metal molding strips above the tub.

Roof. Rafters are 2" by 8", 16" on centers. Heavy asphalt, square-tab roofing on asphalt paper; rock-wool insulation; ventilator openings at south and north of attic. The roof is blue in color to give the house added breadth and to make the brick seem whiter. Flashing and ducts, galvanized iron.

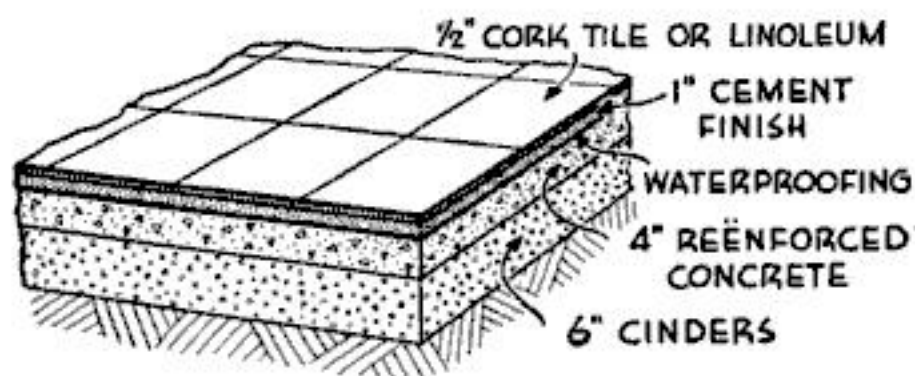
Woodwork. White-pine cabinets and shelves, exterior doors, and overhead garage door. Interior doors are flush birch veneered. Self-closing doors from service hall to the garage and to heater room are metal sheathed on the inside as fire protection.

Windows. Steel casements (opening out) equipped with inside copper screens and winter storm sash. Venetian blinds in rooms facing east and in large bedroom. Heavy pull drapes in living and dining room. Glass blocks, 8" by 8", in heater room and bath. All openings weather-stripped.

Hardware and plumbing. Hardware, satin chrome finish throughout. Pipes, cast iron and galvanized steel; hot-water lines, copper. Outside hose connections shown on plan.

We also have a mental picture of each room just as we'd like to have it—the color schemes, the furnishings, and the useful built-in features.

Living room. The walls will be painted a very light tint of dusty coral. The rug will be dark blue, and the other accents in shades of blue, ivory, and coral. The built-in shelves and cupboards around the fireplace provide space for wood storage and books. Card tables and games slide into the deep cupboard beneath the bookshelves, which opens toward the dining room. Heavy pull draperies draw across the large windows. The windows reach from the ceiling to 1' 3" above the floor. Ceiling height is 8'. Folding doors open from the dining room onto the outdoor terrace. The fireplace is white-painted brick



A reinforced concrete slab forms the foundation for the floors. In the living room, bedrooms, and hall, it is covered with cork-tile flooring; in the kitchen, laundry, and bath, with linoleum

Winning Home

HOUSE CONTEST

like the exterior walls and has a 2' 6" high opening. The mantel, 2' above the fireplace opening, projects 3". The mirror recessed above the mantel reflects the view from the large windows.

Large bedroom. Walls tinted a light, rosy beige, with the furnishings and drapes in accents of blue-

green and eggshell. There are shelves and cabinets at each side of the bed handy for books, radio, and lamps. The closet opens by folding back the wood-panel doors and lights as the door is opened. Separate built-in drawers and shelves at the side of the clothes closet take care of other clothing.

Spare bedroom or study. Light cream-tinted walls with green and rust and natural wood accents in the furnishings.

Bath. Light green and yellow colors in waterproof wall paper are repeated in curtains, floor, and shower curtains. The large storage closet at the right of the door, and the low linen storage shelves with sliding glass-front panels, provide plenty of storage space. Vertical tube lights at each side of the lavatory mirror give light for shaving.

Kitchen. Walls, cabinets, and woodwork white. Deep blue linoleum on work surfaces, breakfast table, floor, and wall back of sink. Wall cabinets at both sides and floor cupboards on three sides provide lots of storage space. Besides these, the glass-front cupboard at the right of the door into the dining room is built especially for pretty china. The cabinet at left of door holds brooms and mops. Indirect lighting over the sink and on the bottom of the wall cabinets shines down on the work surfaces. The sink will have a built-in garbage disposer. The service entrance from the back terrace is a "Dutch door," the top of which may be opened for cross ventilation.

Laundry. Floor and walls same as in kitchen. Equipment will consist of ironer, washing machine, washtubs with cabinets beneath, sewing machine, and cupboard.

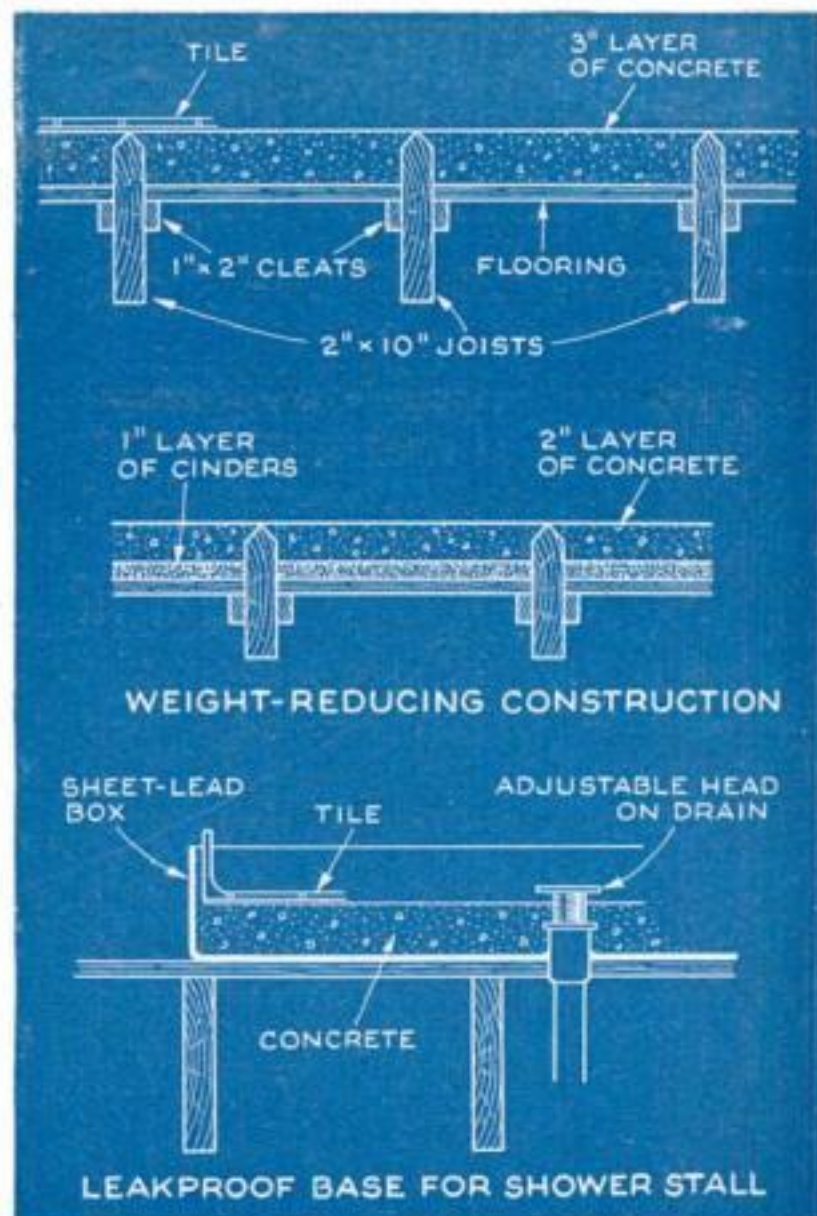
Garage. The large workbench with storage space beneath is a handy, quiet, pleasant spot for working. It would be warm in winter, too, since the register is above it.

Heater room. The space not taken up by the forced-air circulation, gas-burning heater may be adapted to darkroom space by closing a shutter over the glass-block light panel. The heater may be used to circulate cool air in summer, and the automatic gas water heater provides hot water at all times. All register grilles are located in the walls at a height of about 7' so that they are above the occupancy zone, and the heat is deflected downward.

How to Prepare a Concrete Base for Laying Floor Tiles



Installation of a shower stall, above, requires lead sheeting to prevent leaks. Right, pouring concrete



A SUCCESSFUL job of laying floor tiles depends to a large extent on the supporting quality of the base provided. A substantial concrete base can be installed on conventional wooden floor joists without raising the level of the floor. First remove the floor boards, then ridge the top edges of the joists, nail cleats on their sides 3 $\frac{3}{4}$ " from the top, and reinstall the floor boards in a recessed manner as shown in the drawings. In this way a substantial support is provided for the concrete.

Two-by-ten joists, spaced on 16" centers and of approved load-bearing length, will support the weight of a 3" layer of concrete. Joists of smaller dimensions, however, may call for a reduction of weight, which can be accomplished by using a 2" layer of concrete over a 1" layer of cinders.

A reasonably dry concrete mixture consisting of 1 part Portland cement, 2 parts washed sand, and 3 parts clean pebbles should be used.

The floor area on which a built-in bathtub is to be laid (the right background in the photos) can be constructed in the usual manner, with the floor boards laid on top of the joists. However, to safeguard against water leakage from a tiled floor shower stall, incase the con-



crete base in a box built of lead sheeting in which a hole has been prepared to receive the floor drain. All joints and seams must be tightly soldered.

IDEAS *for* HOME OWNERS

TWIN PAILS HELD TOGETHER for easy carrying (or carrying twice as much), and for convenience in working with two different liquids, are a farm and household aid now made possible by a special bracket. The device is handy where a cleaning solution and rinse water are both needed, or for carrying grain and water to poultry or cattle. Ordinary two-gallon pails come with the holder.



Either pail slips out of the holder for refilling without disturbing its twin, yet the attachment clamps them firmly



POWDERED ASPHALT mixes with kerosene, gasoline, turpentine, or other solvent to form a paint for brushing and spraying, or it can be worked into a pliable, puttylike substance. As a paint it will preserve fence posts, damp-proof walls and chests, and waterproof tanks, silos, dams, and fish, lily and swimming pools. The plastic is useful for repairing leaky roofs, cellars, chimneys, door and window frames, laying walks, providing a mastic for tile and brick, and other jobs where it can be applied with a putty knife or trowel. Its melting point is over 200 deg. F.



PAINT AND VARNISH PROTECTION from alcohol stains, hard scrubbing, and scuffing from shoes can be obtained with a synthetic, water-clear finish that can be brushed on over the painted surface. It will not discolor light tints or natural woods, can be applied over both flat and glossy surfaces such as enamel, and may be used either for interior or exterior work. The finish will dry hard overnight. It will be found of special value on window sills and floors that get a great deal of wear.



HOUSE NUMBERS VISIBLE AT NIGHT are made of clear methyl methacrylate, a plastic that reflects light without glare. The numerals are constructed with a series of tiny saucers which catch and reflect street lights. They are backed with thin metal and outlined by a plain, transparent rim of plastic. The saucers give the reflected light just enough spread to provide a wide angle of vision. The numbers are, of course, legible by day also. Letters for name signs likewise are to be offered.

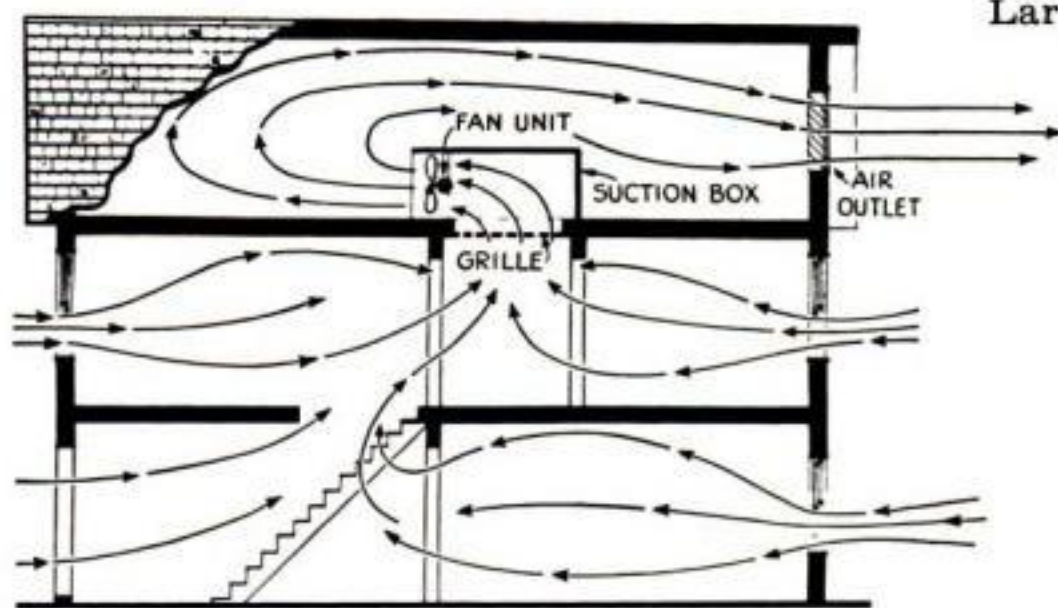
DAMP HOME BASEMENTS CAN BE DRIED by means of the same moisture-absorbing calcium chloride used in industrial plants. The home container (below) has a suspended triple V-shaped basket that holds ten pounds of drier flakes and a basin to catch the condensed moisture. One unit will dry up to 1,000 cubic feet of space. If two are employed, they are placed at opposite sides of the room. The chemical is replaced as necessary.



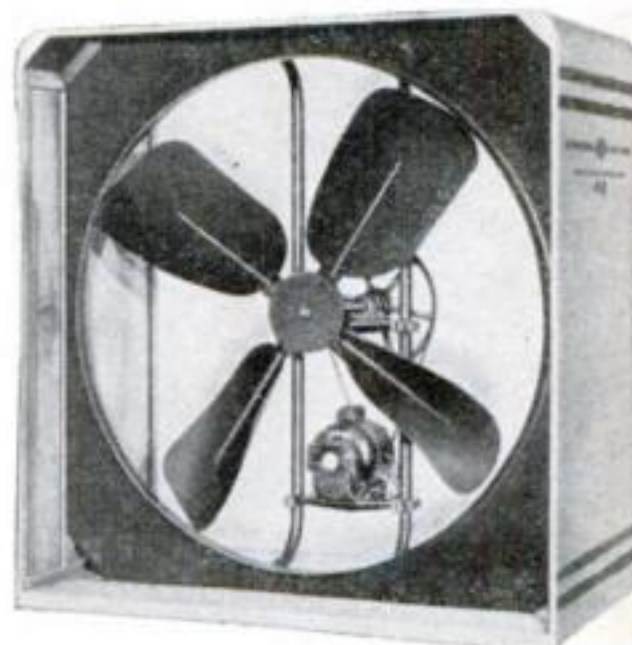
FLOODLIGHTED GARDENS, ENTRANCE GATES, house doors, or outdoor fireplaces are often desirable. A handy flood-lamp holder now on the market (above) has a flexible arm mounted on a 12" spike which can be pushed into the ground by hand. It is completely weatherproof and has a six-foot rubber cord for connecting to the house current. The holder is designed to take a reflector bulb of either 75 or 150 watts. It is readily adjusted by hand, remaining in any desired position.

COOLING UNITS ADAPTED FOR HOME USE and the needs of different types of houses have been developed after several years of research and are now available in three sizes. Installed according to rules worked out in the laboratory, a fan and grille in the attic draw cool air through the doors and windows of the lower floors and expel heated,

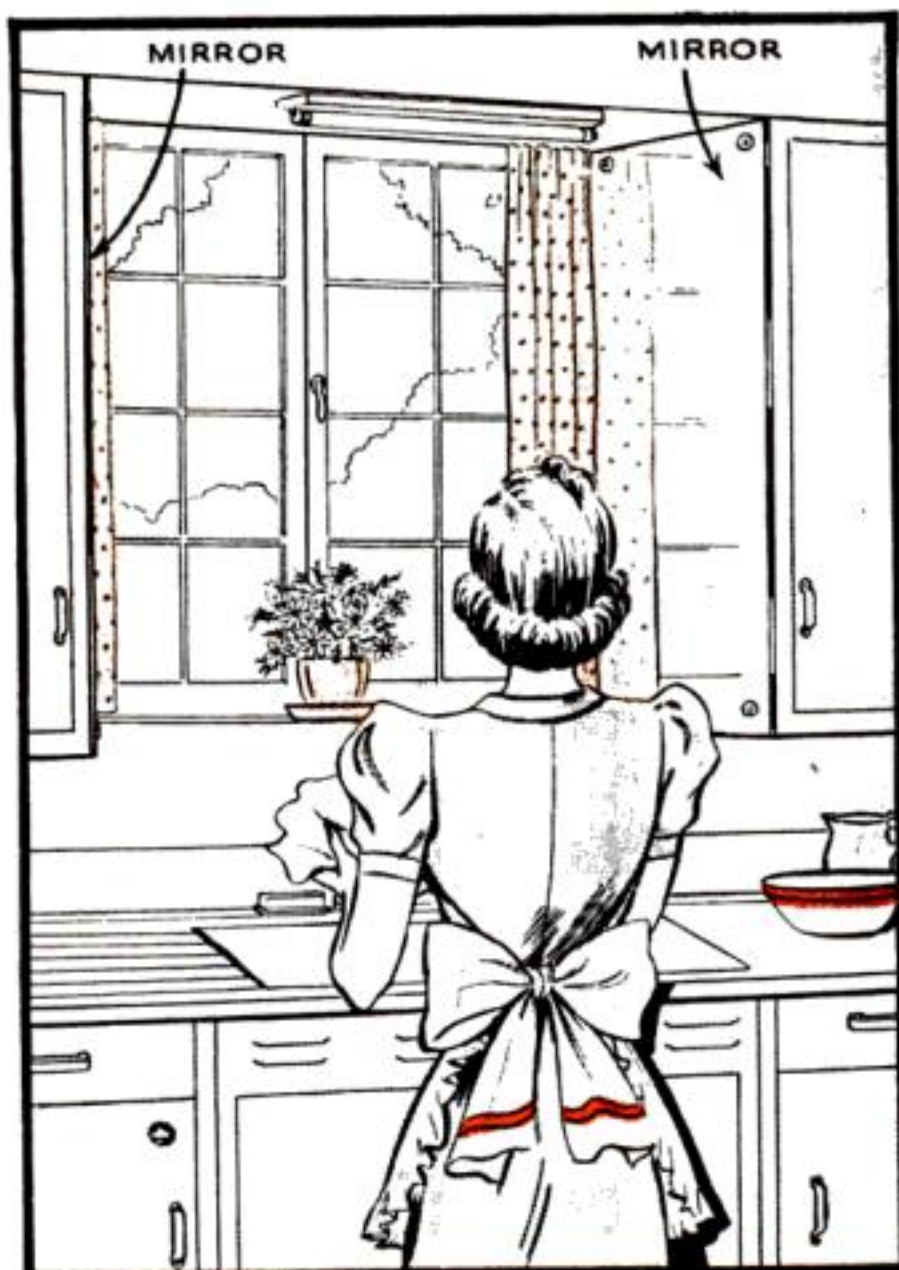
stagnant air above, providing a complete change as often as once a minute. The fan unit is enclosed in a square wooden housing, which is mounted on rubber blocks and designed to prevent transmission of noise. The frame can be made to fit any suitable attic opening. The size of the cooling unit needed is determined by adding up the cubic content of all living space in the house. Larger sizes are needed in hot climates.



Diagrammatic section of house showing air movement with typical home-cooling installation. At right is the fan in its casing



KEEPING



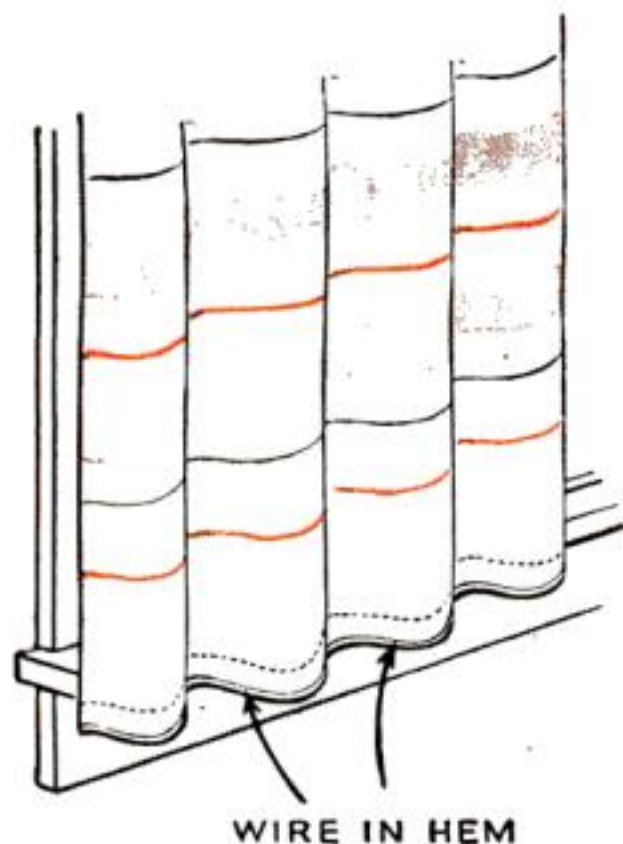
In kitchens that have but one window in the wall behind the sink and dish cabinets, mirrors fastened to the ends of the latter improve general illumination by reflecting light from the fixture and from outdoors, brighten the counter under the cabinets, and add a sparkling decorative touch



Short-stemmed flowers can readily be arranged with others in a bowl or vase by slipping the stems into transparent green cellulose drinking straws, which are unnoticeable in the bouquet



The deposit that forms on an iron used at too high a temperature on rayon is easily removed without scratching the surface by rubbing it gently with fine steel wool, soap, and water



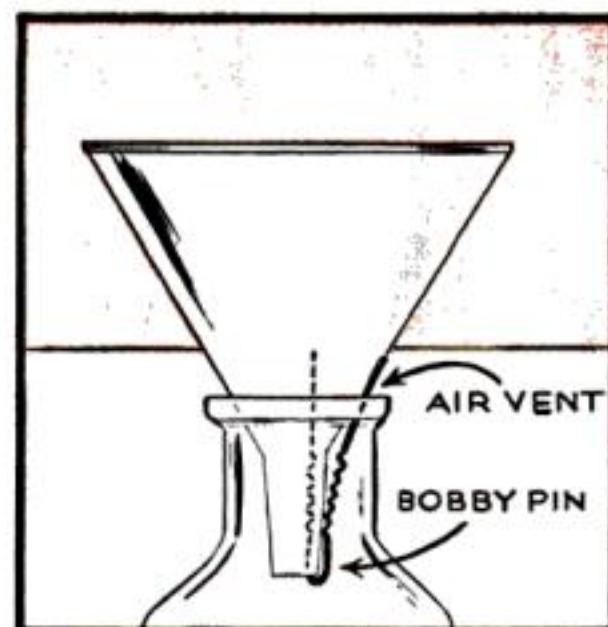
WIRE IN HEM

Stiff or newly washed curtains sometimes hang awkwardly. If heavy wire is inserted in the lower hem, it may be bent to form even folds, and its weight helps draw the curtain straight



ADHESIVE TAPE

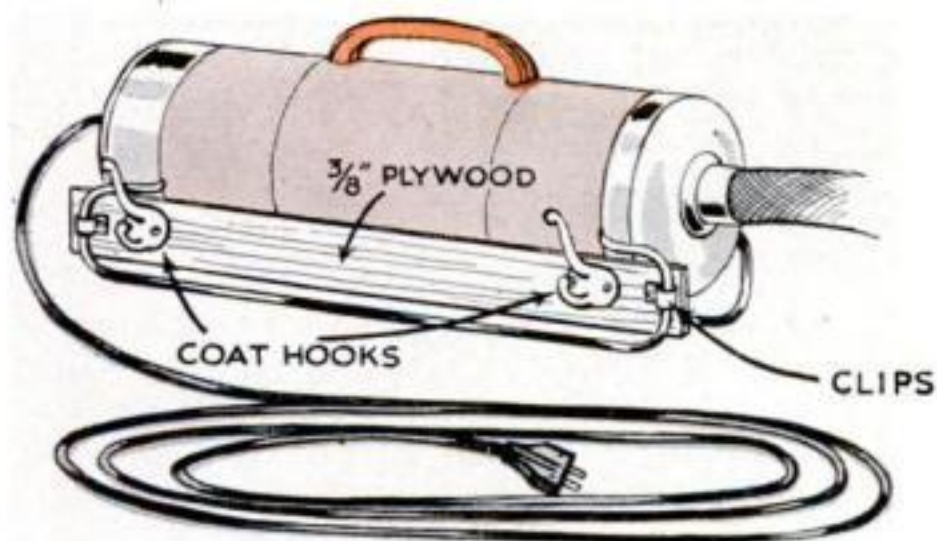
Celery can be cleaned quickly by scraping it with a piece of a broken hack-saw blade. Wrap several layers of adhesive tape around one end of the blade so that it may be gripped safely



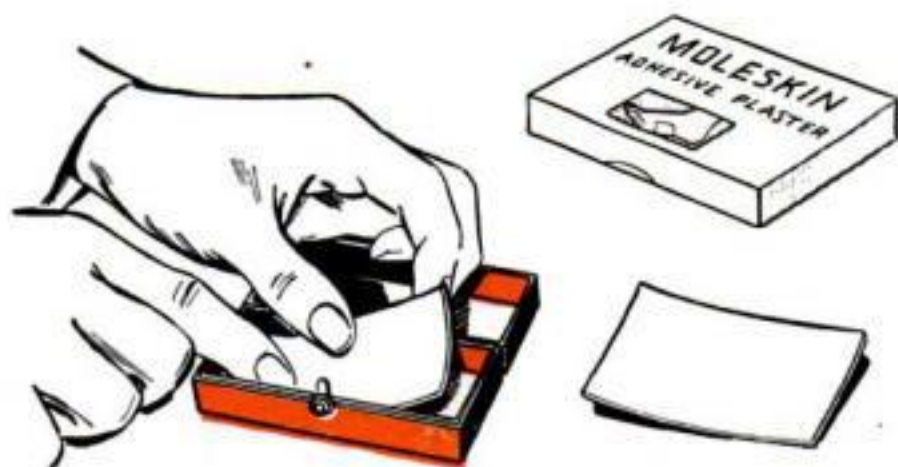
AIR VENT
BOBBY PIN

When a funnel fits the neck of a bottle snugly, trapped air often results in a sluggish flow of the liquid. In order to leave an air vent, slip a new, clean bobby pin on the edge of the spout as shown

THE HOME SHIPSHAPE



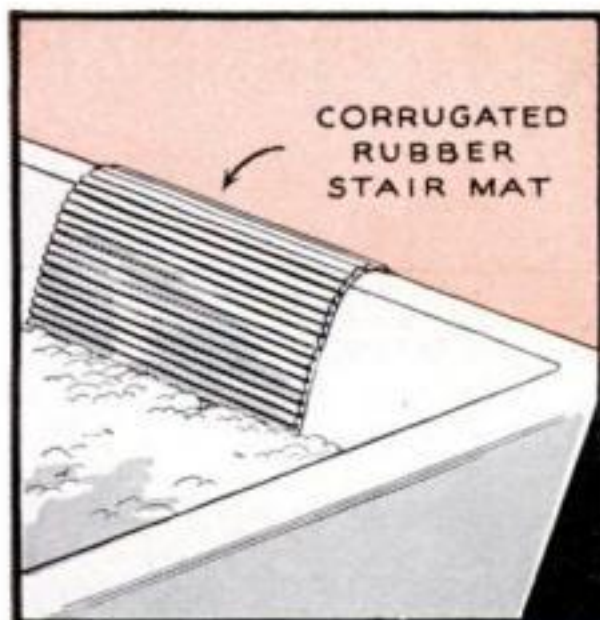
Tank-type vacuum cleaners are more easily carried if the electric cord is looped out of the way on the holder shown above. Fasten the plywood to one runner with clips bent from thin strap iron



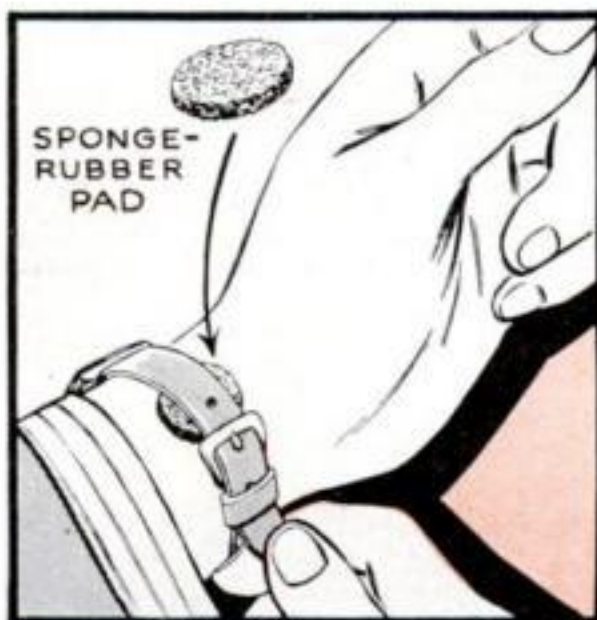
Moleskin adhesive plaster such as is sold for protecting the feet is excellent for lining boxes or fitted cases in which camera filters, lenses, jewelry, or delicate instruments are kept. Cut to shape, peel off covering, and press plaster into place. It is also suitable for lining lens caps



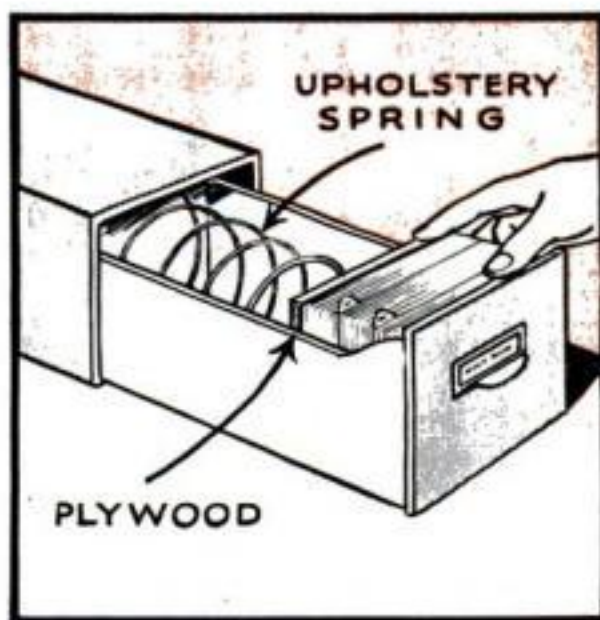
For household painting, a big paper picnic plate makes a convenient "catchall." If the paint can is glued to it, accidental tipping and spilling are almost impossible. Such a plate will also catch brush drippings and runs from the edge of the can, besides providing a place to lay the brush



A corrugated stair tread hung on the edge of the laundry tub replaces a cumbersome washboard for occasional rubbing, takes no extra space, and is conveniently at hand when needed



If you dislike tightening your wrist-watch strap excessively, but wish to keep the timepiece from slipping around, cement a sponge-rubber disk to the underside of the strap near the buckle



A soft upholstery spring placed behind the cards or folders in a partially filled filing cabinet will hold them upright and in proper order. The spring should bear against a plywood backing

By **EDWIN M. LOVE**

WHEN a man has set up his power jointer, he all but retires his hand planes. The machine will do much more quickly, and often more accurately, most of the woodworking jobs formerly done with such hand tools. The principal parts of a typical jointer are shown in Fig. 1.

For greatest convenience, the jointer should be mounted on its own stand, or on a combination stand beside the circular saw. If it must be mounted with other machines on a bench, the arrangement should be such that no other equipment obstructs the planing of long boards.

What are the first steps in setting up a jointer?

Unpack it carefully, and read the printed directions supplied with it. In bolting it to the stand, see that the motor and jointer pulleys are in alignment, and that the motor spins the cutter head in the direction toward which the knives are inclined. The speed of rotation should be from 4,200 to 8,000 revolutions per minute, the lower speed being preferable if the machine has sleeve bear-

ings. To calculate the size of the motor pulley required, multiply the desired jointer speed by the diameter of the jointer pulley, and divide by the motor speed. Thus, to drive a jointer having a 2½" pulley at 4,200 r.p.m., the pulley on a motor turning at 1,750 r.p.m. theoretically should be 6.6" in diameter, but an ordinary 6½" or 7" stock pulley will, of course, be satisfactory.

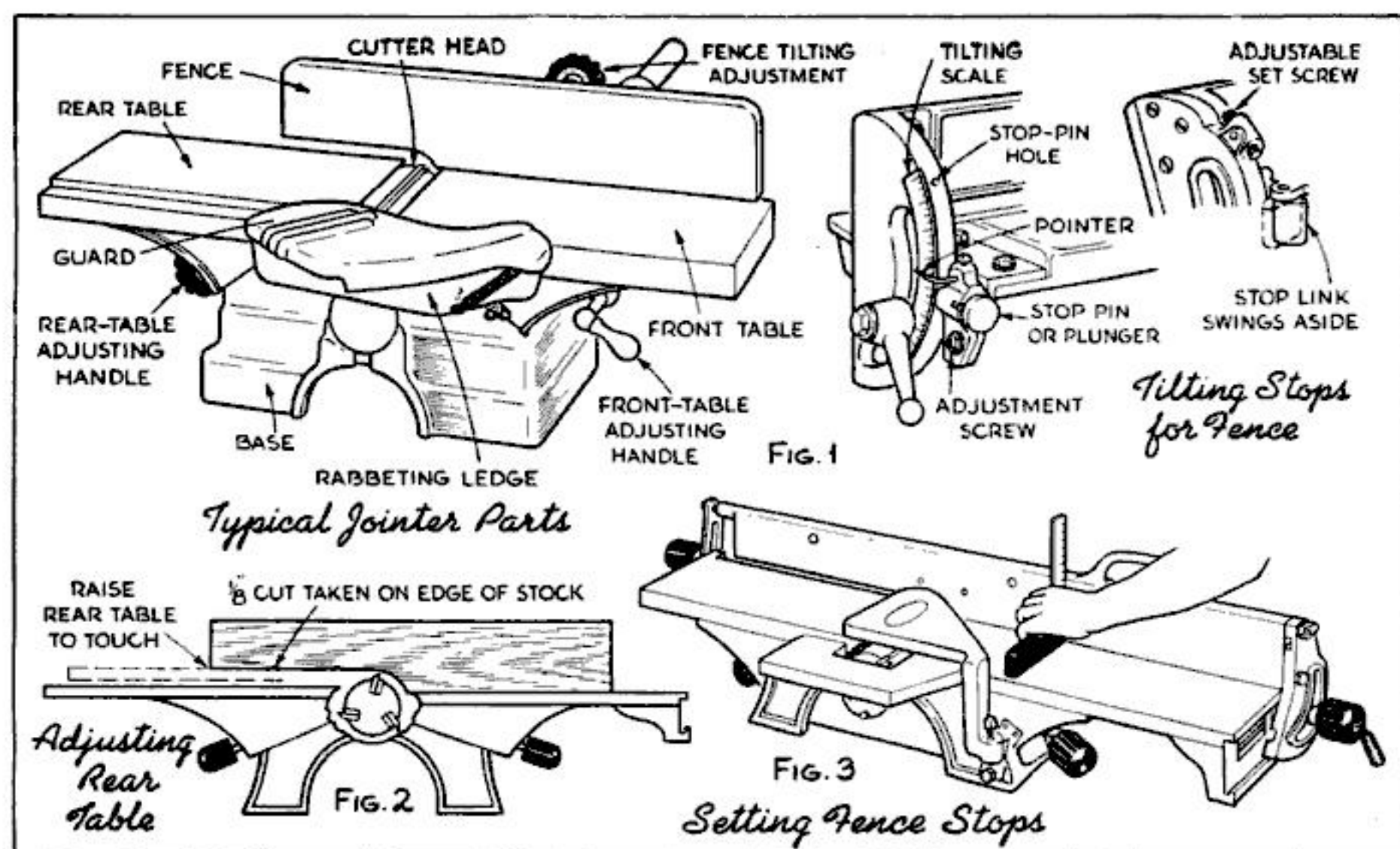
Are any adjustments necessary?

A new jointer is adjusted at the factory. However, three things should be checked—the alignment of the rear or out-feed table with the cutters, the adjustment of the fence stops for square and miter positions, and the setting of the depth-of-cut pointer.

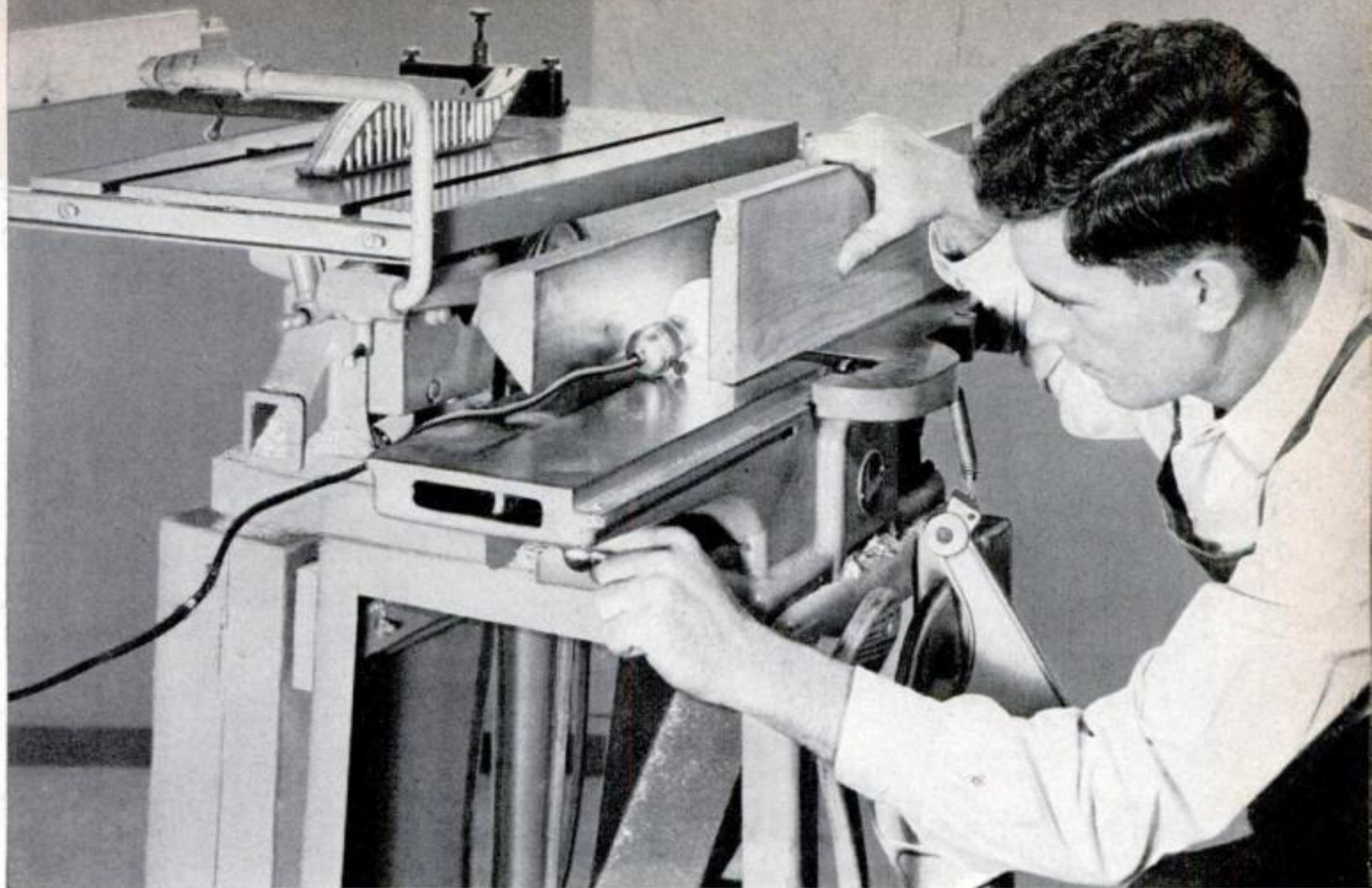
How is the rear table adjusted?

Set the front table for a cut of about ⅛". Unlock the rear table and drop it below the cutters. Plane a few inches along one edge of a board and rest the untouched part of the board squarely on the front table. Then raise the back table until it just touches the cut portion of the board (Fig. 2). If an electric lamp is held behind the board, it is easy to see when contact has been made.

MODERN JOINTERS TAKE THE



Parts of a modern jointer are shown above. For ordinary surfacing, the rear table should be level with edges of the blades in the cutter head. The setting of the front table determines the depth of the cut



An electric bulb placed behind the test board facilitates aligning the rear table. Hold unplanned part of the board firmly down on the front table, then adjust the rear one so that it just touches the cut

DRUDGERY OUT OF PLANING

In what manner is the fence checked?

Test it for squareness with a try-square (Fig. 3), or by making trial cuts on a thick board, and adjust the stops. Check the miter stops with a bevel square set for 45 deg. and 135 deg.

What is necessary to set the depth pointer?

Lower the front table and take a cut of exactly $\frac{1}{8}$ ", then loosen the screw holding the pointer, shift the latter to the correct position, and retighten the screw.

How is a board jointed?

To joint a board, which means to straighten and square one edge of it, set the jointer for a cut of $\frac{1}{8}$ ", with the fence at 90 deg. Holding the stock firmly against the fence and the table, push it over the cutter head. If the board is wide enough, hook some of the fingers over the fence. If the work is narrow, bend the lower fingers to keep them well above the cutters.

Start the cut with the edge bearing on the front table, and as soon as a few inches

have been planed transfer the pressure to the rear table. If the front end of the board strikes the edge of the rear table, or the depth of cut lessens when the work is held down on the latter (as indicated by a change in the tone of the machine), the rear table is too high. If the cutter gouges the end of the piece, the rear table is too low.

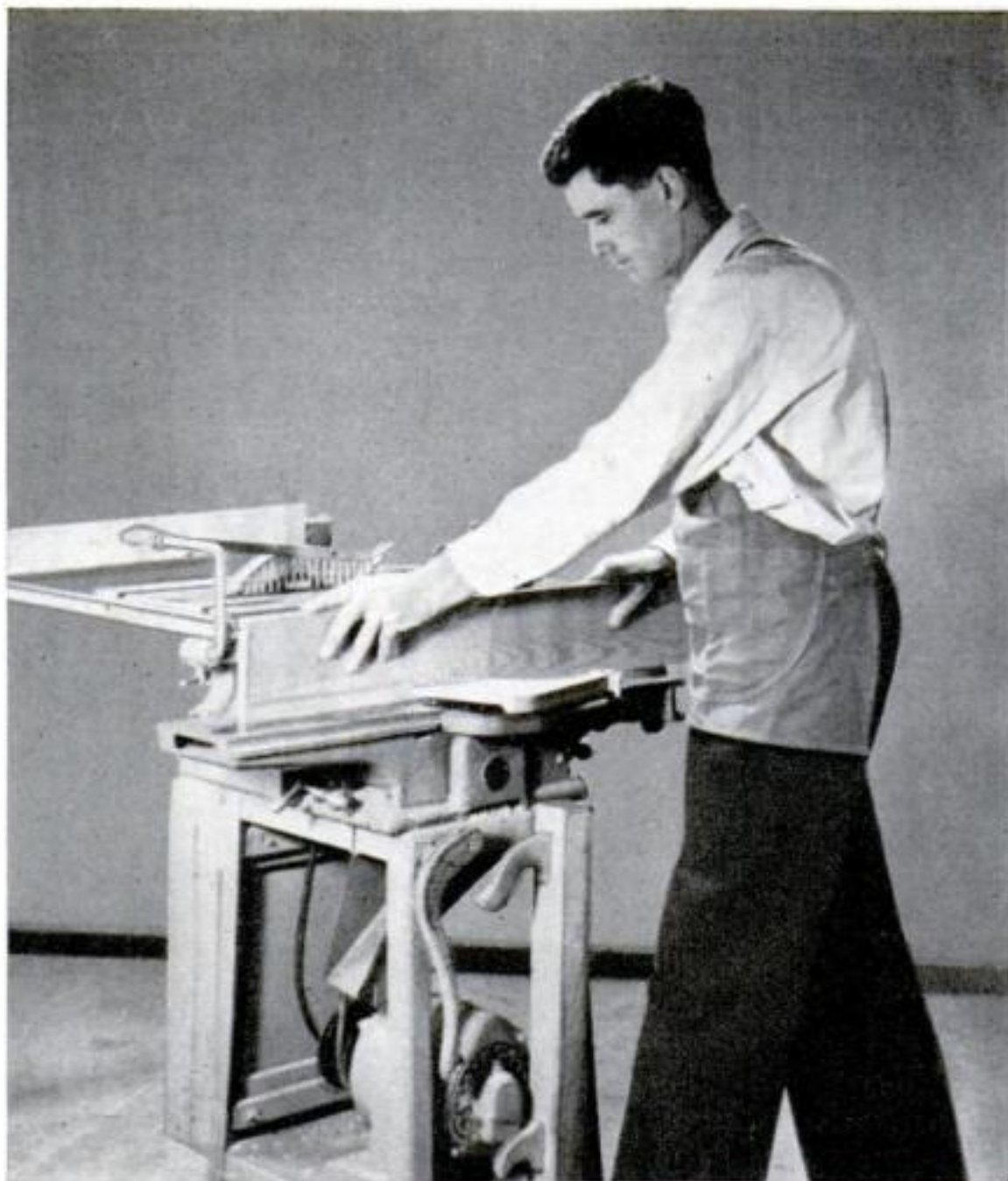
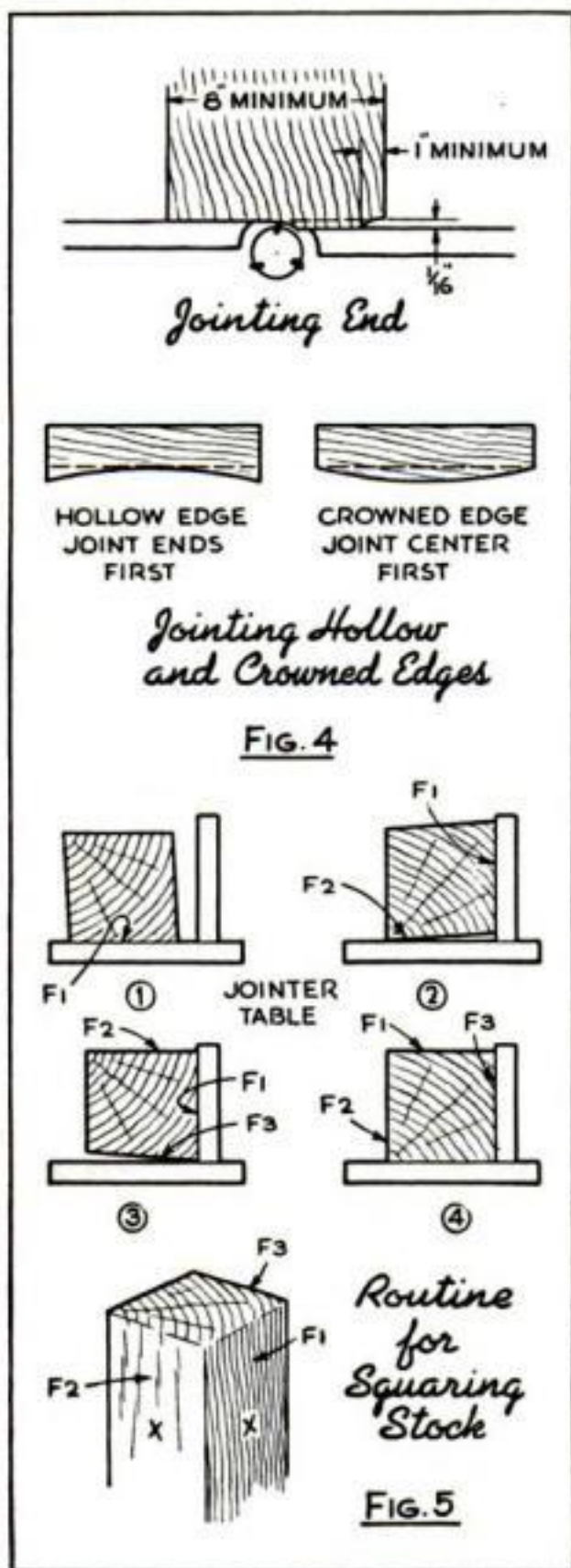
It is safe to bear down on stock directly above the cutter head, but if the operator prefers, he can advance the work into the cutters, placing the left hand over the rear table when a sufficient length of the piece rests on it. However, pieces shorter than 10", and thin stock, should not be jointed without special holding devices.

Although a sharp jointer will cut quite smoothly against the grain if the stock is fed slowly, it is best to cut with the grain whenever possible.

To joint a board with a hollow edge, run the ends over the cutters first; if the edge is crowned, joint it flat at the center to obtain a good bearing surface (Fig. 4).

Can the ends of boards be jointed?

Yes, provided the stock is at least 8"



The operator should stand in front and slightly to one side of the jointer, holding the work firmly against the fence and the table with both hands. Use the safety guard whenever possible

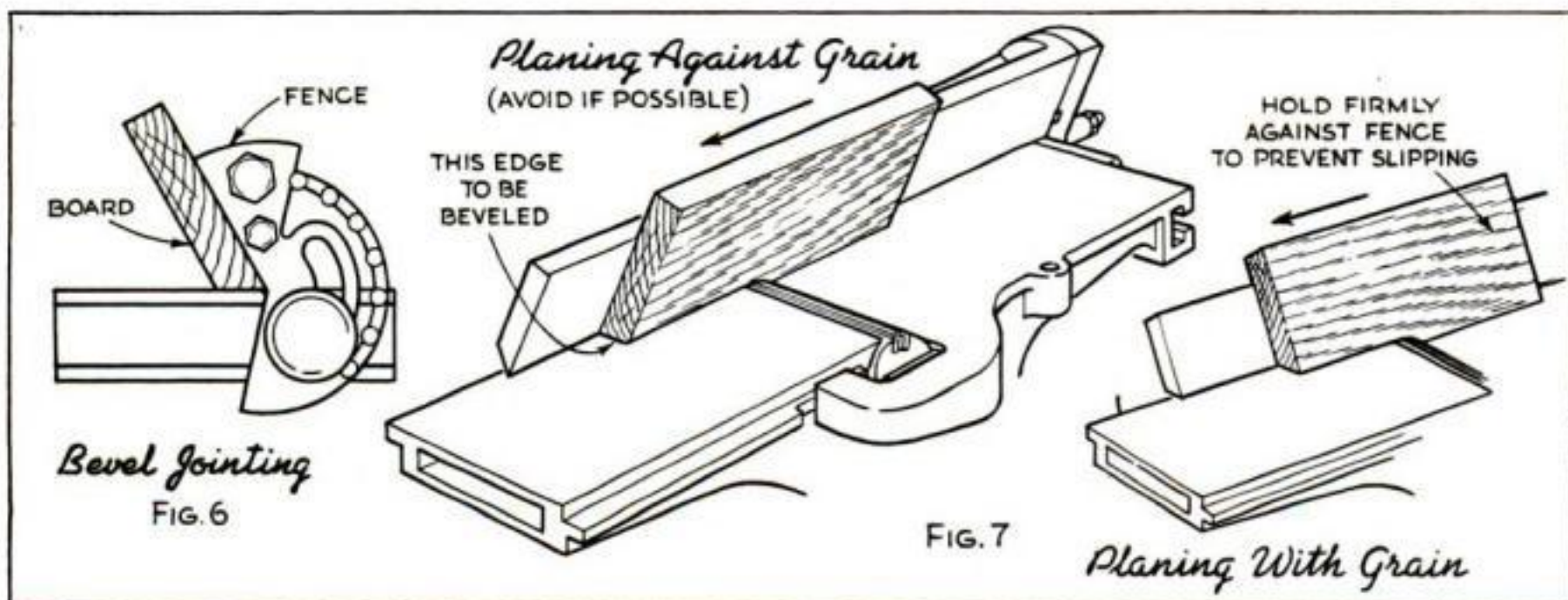
At left, squaring up stock. Below, for planing smooth bevels, tilt fence as needed for cutting with the grain

How is stock squared?

Thick stock, such as for table legs, is squared by the following procedure:

Select the best face, joint it with the grain, and mark it (Fig. 5). Pass an adjacent side over the jointer with the first side pressed flat against the fence. Turn the piece end for end, and joint a third side. Lastly, plane the fourth side with the second or the third against the fence. This squares the stock,

wide. Take a cut of 1/16" or less, and stop before reaching the rear edge, to avoid splintering. Finish by hand. An alternative method is to joint 1" at one edge, then turn the work and finish the cut from the other edge. For long boards it is best to fasten on an auxiliary vertical fence.





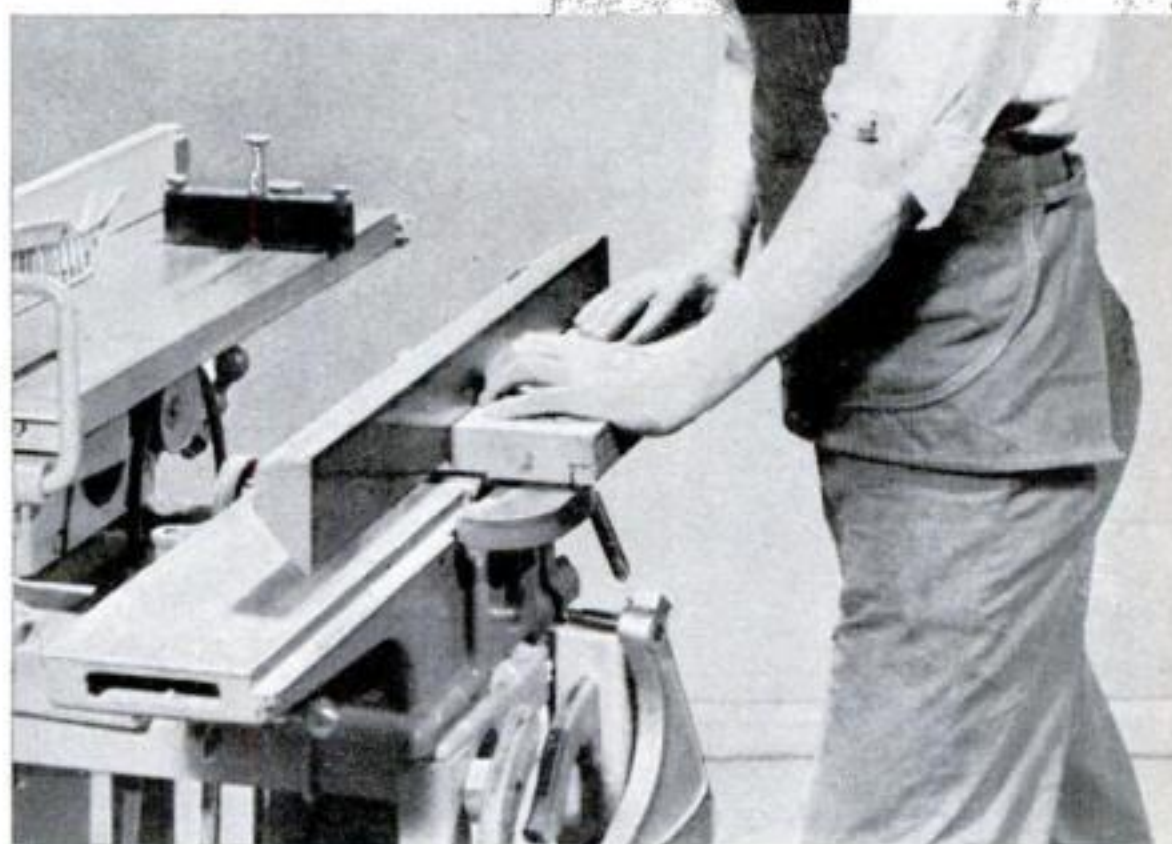
For surfacing short pieces or thin stock, use a push block such as is shown at the left. This not only protects the hands from possible injury, but will keep light work flat and rigid on the table. For a good grip on the stock, fasten a cleat across the back end of the block, or else glue coarse sandpaper firmly to its undersurface



but the width and thickness will not be uniform unless they were so to begin with. However, they can be made so by taking more than one cut where necessary, by varying the depth of cut, or by both.

What adjustments are necessary for beveling?

Simply tilt the fence "in," as in Fig. 6, or "out" to the desired angle. If a smooth cut is desired, study the grain structure and joint the piece with the grain (see Fig. 7), tilting the fence as may be necessary to plane the required bevel.



In rabbeting, the fence is set for the desired width, and the work is fed against the cutter head by sliding it along on the rabbeting ledge. End rabbets also can be formed by using a backing block

Can thin strips be planed on a jointer?

Yes, it is easy enough if a push block is used. Notch the bottom of a piece of $\frac{3}{4}$ " or thicker stock and provide it with a handle (see data card, P.S.M., June '40, p. 147). The block will hold thin stock flat, and also serve the purpose of helping push the work over the cutter head.

How is rabbeting done on a jointer?

Remove the guard, set the fence at a distance from the ends of the knives equal to the width of the desired rabbet, and lower the front table to the required depth. Slide the work along on the rabbeting ledge, as shown in one of the photographs.

Next month: advanced work on the jointer.

Sewing Cabinet in Swedish

By **JOSEPH ARONSON**

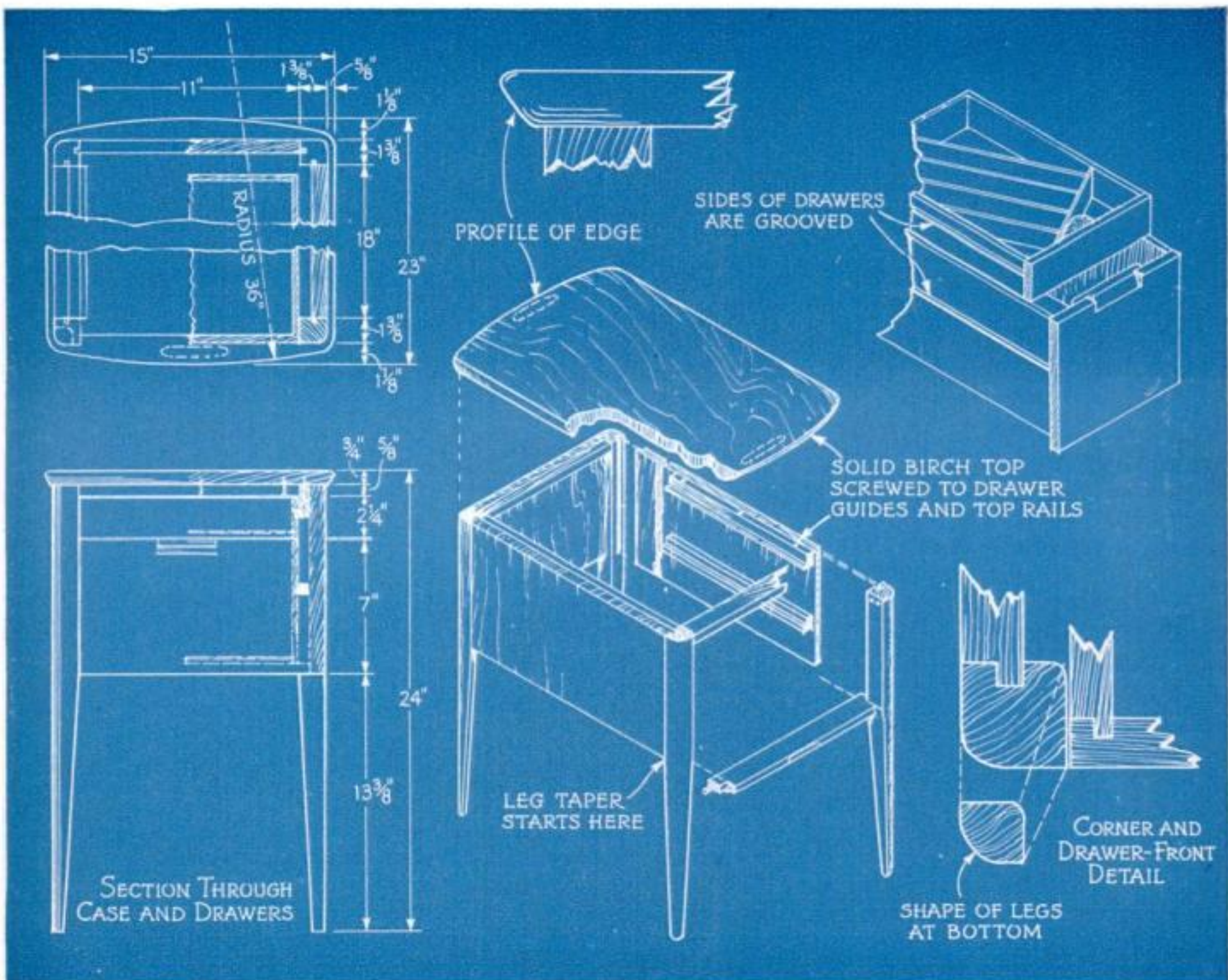
Author of *The Encyclopedia of Furniture*

IF YOU are planning to construct a piece of gift furniture for Christmas, it is not too early to select a good project. For this purpose, there is nothing better than a sewing cabinet or table. Besides, every home workshop *must* produce a sewing table sooner or later . . . if only to appease the distaff side of the household for those long evenings spent at the workbench!

This design is in the form of a straight-forward end table, but with drawers specially planned to hold sewing supplies and work. The piece is light enough to be moved about, and it has a fixed top, rather than one which opens, so that there will be a place for the sewing lamp. Although the frankly functional modern style is used, it is tempered with the delicacy and refinement of the Swedish school.

Birch plywood is used for making the case, its grain running vertically to match that of the legs. The top is of solid birch, screwed fast to the top drawer guides. At each of the rounded ends is a finger-grip recess by which the table may be lifted about. The outer corners of the legs are well rounded, and the inner faces below the bottom drawer rail are tapered outward. The plywood sides, which are $13/16$ " thick, are dadoed into the legs.

Note that the drawers run on side guides fitted into the sides of the case, and the drawer sides are grooved to suit. The upper drawer is subdivided to accommodate spools, pins and needles, scissors, and the like. The lower drawer is made deep enough to hold an accumulation of work or folded material. No handles are used. A notch in the front of the lower drawer, and another in the front bottom rail, afford a finger grip on the bottom of either drawer. The drawer bottoms may be recessed slightly just

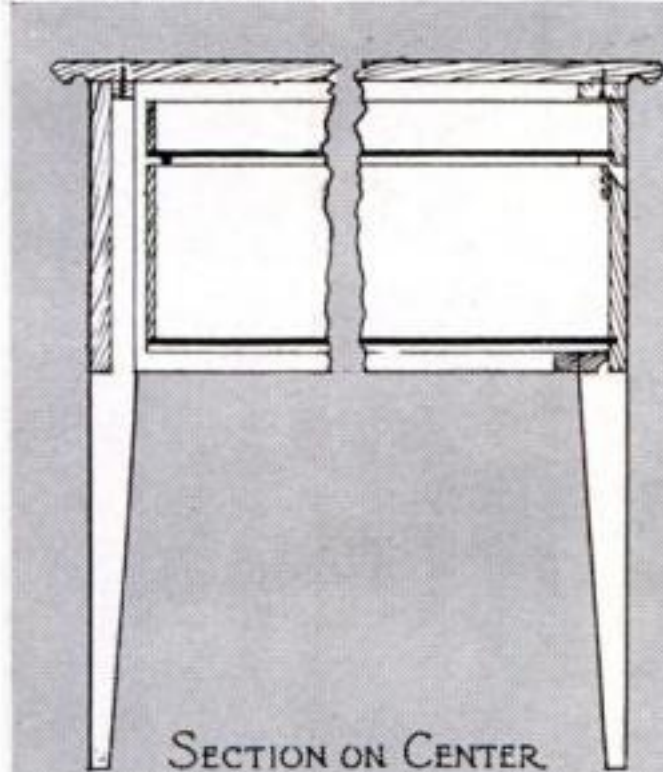


Modern Style

above these two finger notches. If nicely grained wood is used, the ideal finish is one that does not darken the tone, but may be polished to a satiny luster. Two coats of high-grade floor varnish, the first well thinned, may be used for a modern natural-color finish. Let dry several days before rubbing down thoroughly with 8/0 waterproof paper and water. Polish with hard wax.



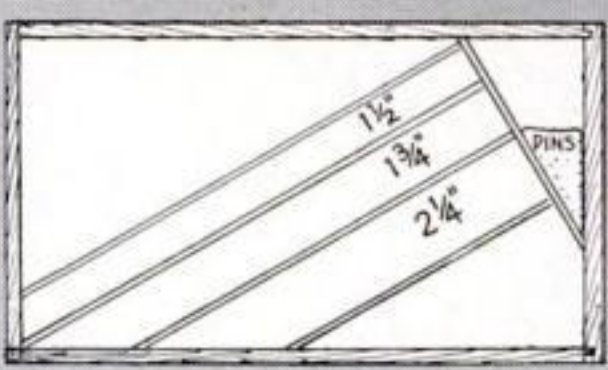
Divisions in the upper drawer of the table permit quick selection of spools, needles, and scissors. Deep lower drawer holds material



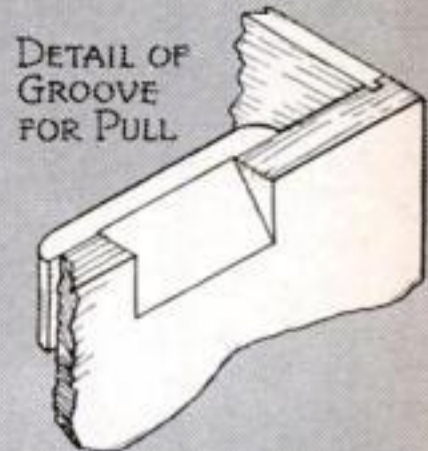
SECTION ON CENTER



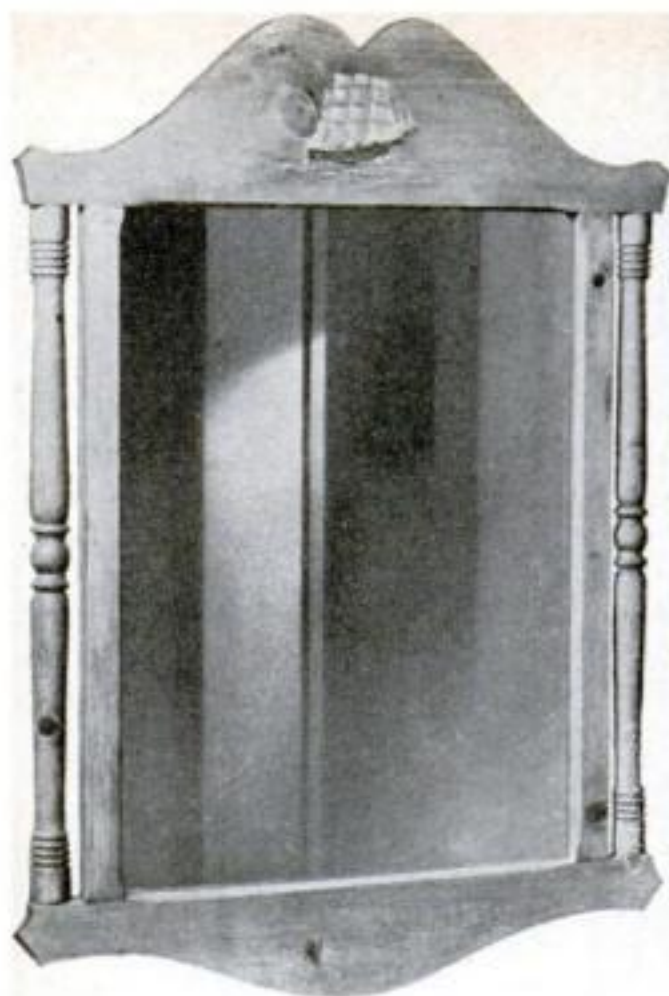
LIST OF MATERIALS				
No. Pc.	Description	T.	W.	L.
1	Top, solid	3/4	15	23
2	Sides, 5-ply	13/16	9 7/8	19
1	Back, 5-ply	13/16	9 7/8	12
2	Drawer guides	7/8	2	18
2	Drawer guides	7/8	7/8	18
1	Front top rail	5/8	1 3/8	11
1	Rear top rail	5/8	5/8	11
1	Front bottom rail	5/8	2 1/2	12 1/8
4	Legs	1 3/8	1 3/8	23 1/4
2	Drawer bottoms, plywood	1/4	10 3/8	18 3/4
1	Top drawer front	5/8	2 1/4	11
2	" " sides	1 1/2	2 1/4	18 3/4
1	" " back	1 1/2	1 3/4	10 1/2
3	" " partitions	1/4	1 3/4	18 1/8
1	Lower drawer front	5/8	7	11
2	" " sides	1 1/2	6 1/4	18 3/4
1	" " back	1 1/2	5 3/4	10 1/2
1	Backing for pull	1 1/2	1 1/4	8



DIVISION OF TOP DRAWER



DETAIL OF GROOVE FOR PULL



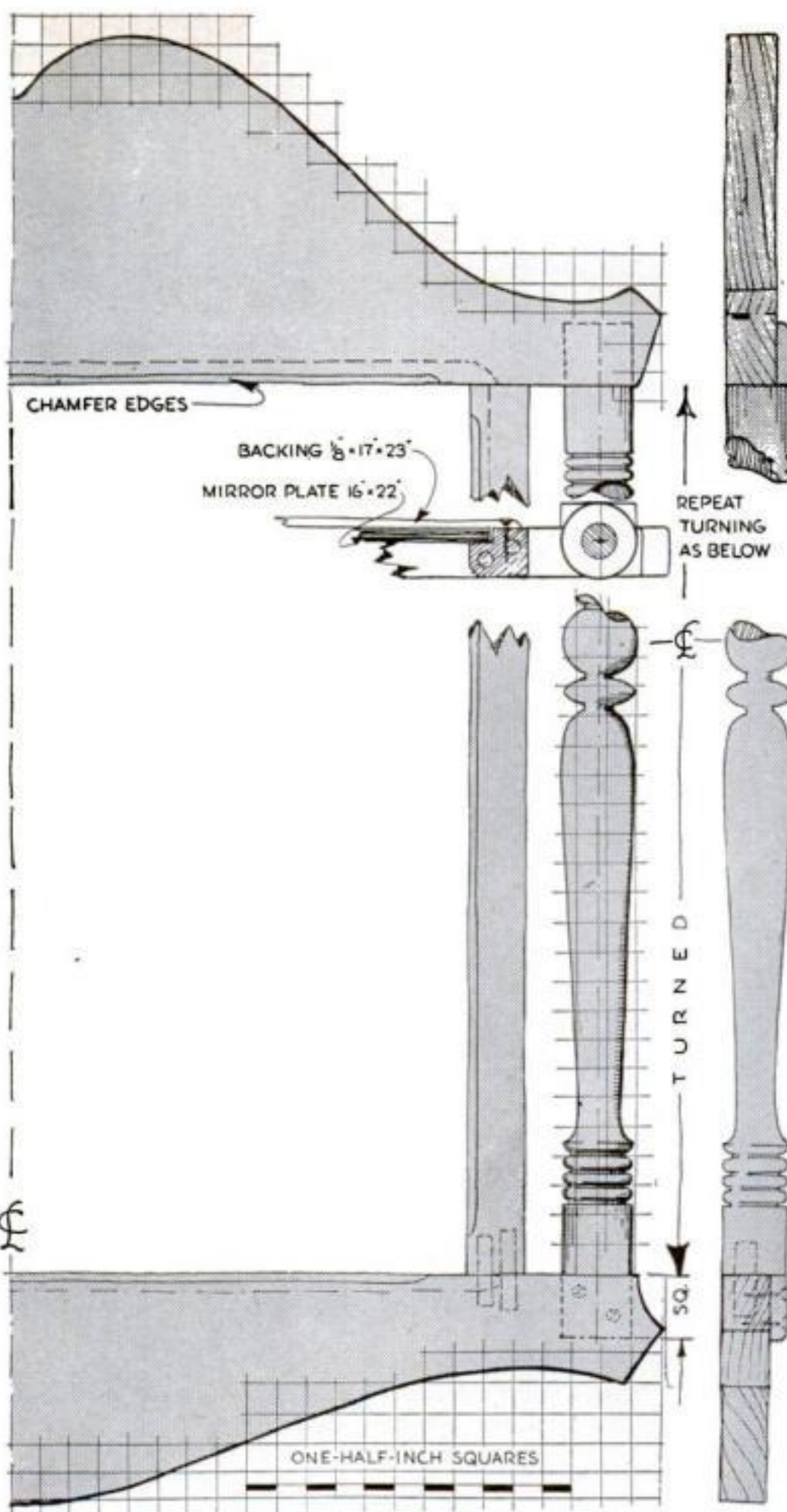
Designed by Joseph Aronson, this decorative framed mirror is an appropriate accessory for any home furnished in Early American style

Colonial Signboard Mirror

A COLONIAL tavern sign was the inspiration for this mirror frame. It can easily be made from a few pieces of old pine or similar wood.

The mirror is actually framed in by the uprights and the top and bottom members, which are rabbeted for the glass. The free-standing turnings are decorative and strengthen the frame. They are doweled in vertically. Since the turnings are heavier than the frame, the excess thickness is taken care of by leaving the ends unturned. The square blocks are then halved out and screwed to the back, as shown.

Sandpaper the frame smooth and soften all sharp edges. To finish, apply several coats of wax, colored with oil color to the desired shade. The large surface of the top member may be appropriately decorated, if desired, with a painted or carved design, such as the painted ship on the frame in the photograph.



All four front edges of the frame are stop-chamfered. The mirror is held in rabbets as shown in the section above

LIST OF MATERIALS

No. Pc.	Description	T.	W.	L.
1	Top	$\frac{7}{8}$	6	22
1	Bottom	$\frac{7}{8}$	4	22
2	Uprights	$\frac{7}{8}$	1	21½
2	Turned uprights	1¼	1¼	23¾
1	Back	$\frac{1}{8}$	17	23

Note: All dimensions are given in inches and are finished sizes.

Drawer Holds Record Player and Muffles Scratch of Needle

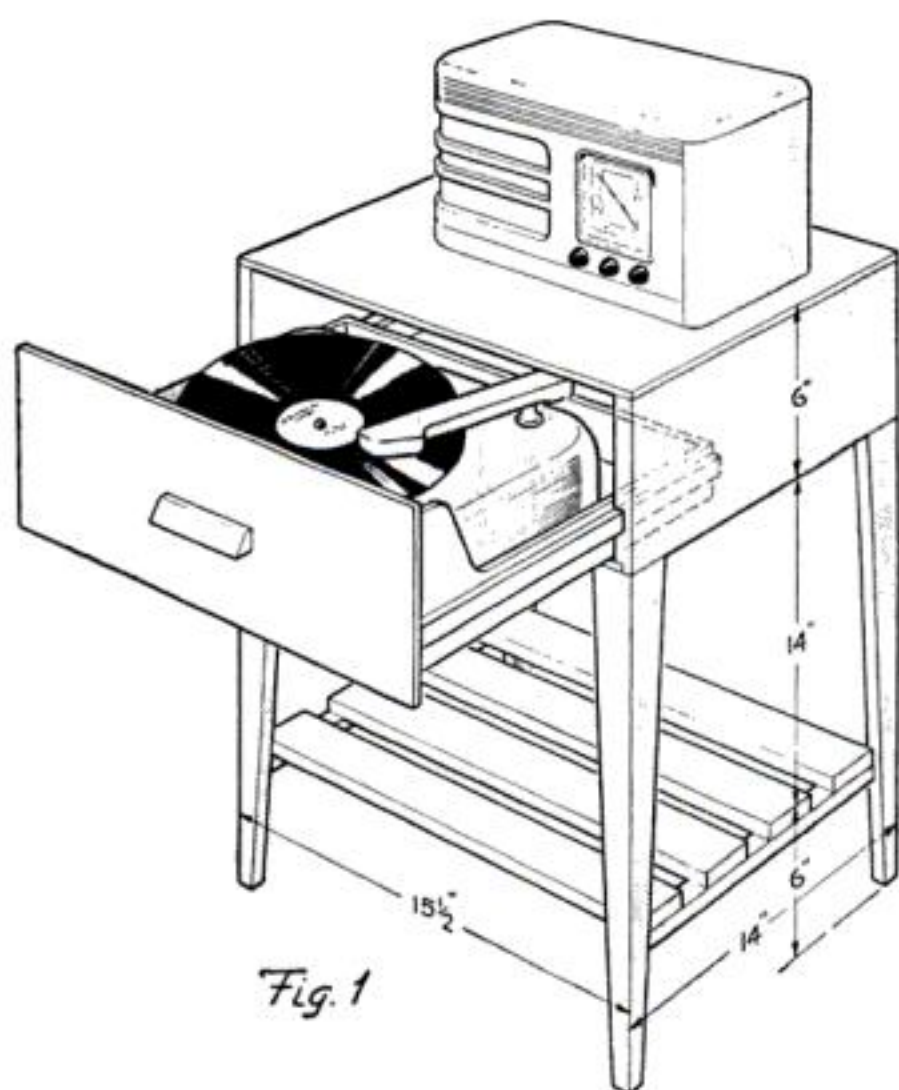


Fig. 1

INSTALLING a record player in a drawer in a small end table greatly improves its performance by muffling the needle-scratch and motor noise. The radio may be placed on the top of the table, and a shelf below will hold a record rack or record albums.

The table illustrated may be constructed with a dollar's worth of lumber. A piece of white pine $\frac{3}{4}$ " by $5\frac{3}{4}$ " by 4' is needed for the sides of the table and the front of the

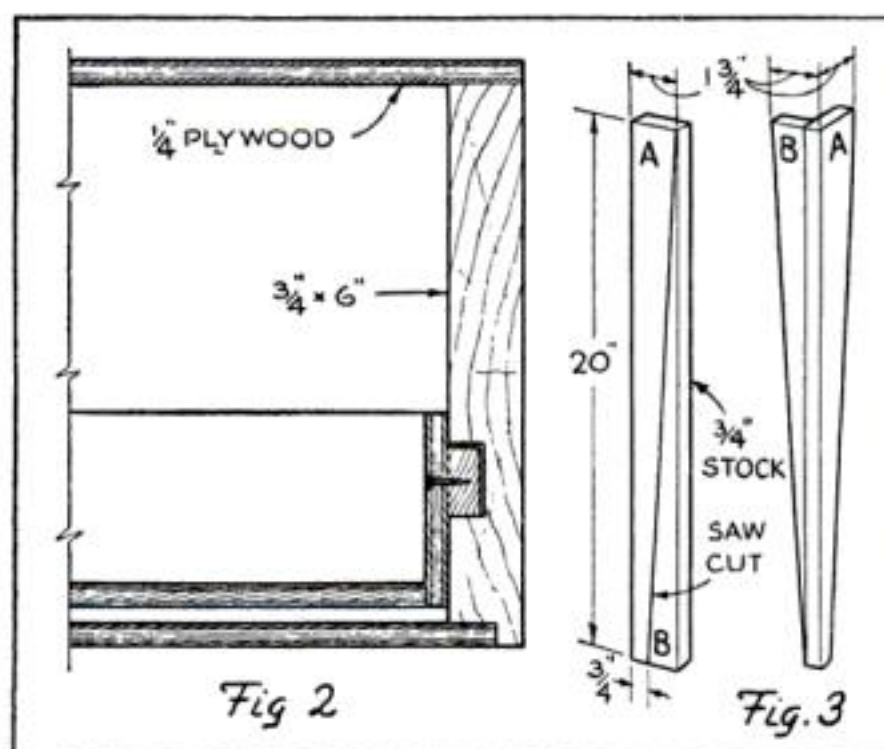


Fig. 2

Fig. 3

A $\frac{3}{8}$ " thick strip glued and screwed to the side of the drawer, and fitted to a groove in the table side, will make sliding easy and prevent tilting

drawer. A piece of $\frac{1}{4}$ " plywood 2' by 4' completes the table and drawer, while the legs are sawed from a strip of white pine $\frac{3}{4}$ " by $1\frac{3}{4}$ " by 7'.

Dimensions depend to some extent on the size of the record player, so those suggested in Fig. 1 may be modified as necessary. The drawer will slide easily if constructed as shown in Fig. 2. A simple way to make each tapered leg is to cut a piece of $\frac{3}{4}$ " by $1\frac{3}{4}$ " stock into two pieces and fasten them together as in Fig. 3. Small corner braces are used to fasten the legs to the upper part.—LILLIAN PETERSON.

COMMON MORTISE-AND-TENON JOINTS [WOODWORKING]

1. Only the tenon cheeks are cut. Suitable for members joining other parts some distance from end.

2. Edges also cut. The shoulders hide the ends of the mortise, and this usually results in a neater joint.

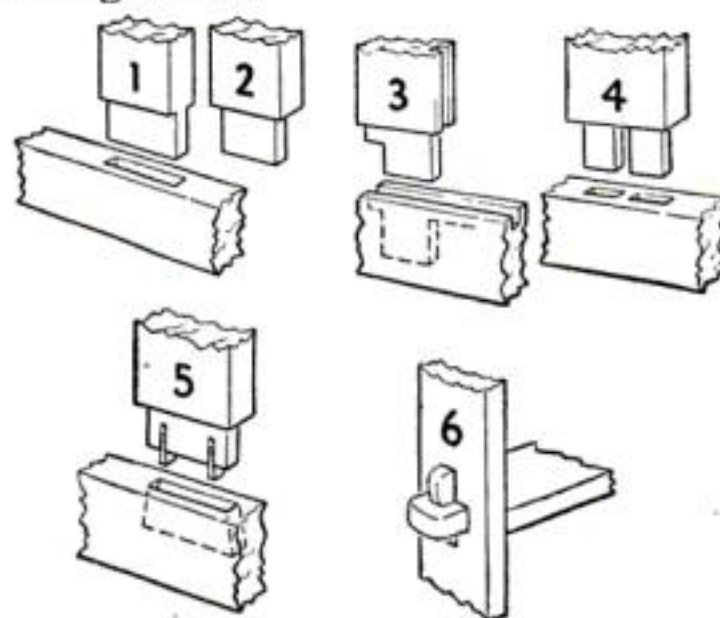
3. For doors. Members are grooved to receive a panel, and tenon has a step to close end of groove in stile.

4. Double tenon, used on wide rails or where extra strength is needed.

5. Fox-wedged tenon. Hardwood wedges are inserted in saw kerfs. Ends of mortise slope outward toward bottom, and the wedges, forced in as the tenon enters, spread the tenon to fill the dovetailed mortise.

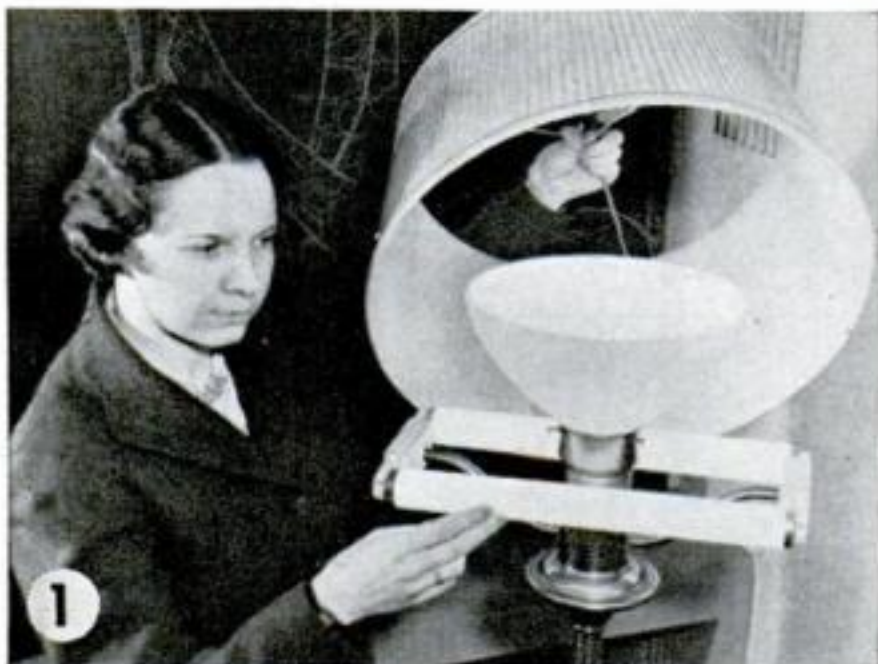
6. Keyed mortise and tenon. Used

to lock shelves and stretchers in place. Wedge is driven into mortise in protruding tenon.



POPULAR SCIENCE MONTHLY SHOP DATA FILE

New Appliances



1 FLUORESCENT FLOOR LAMPS, containing also a 100-200-300-watt incandescent light in a reflector bowl, are the latest help to sight in reading and card playing. Two 14-watt fluorescent tubes, 15" long, in a special mounting, can be used with or without the incandescent bulb. A shade hides both tubes and reflector from view



2 JIGGER PITCHERS FOR ICED DRINKS are used for lemon juice, cream, syrup, melted butter, rum, or whisky, enabling guests to mix their own. The jiggers are 1½" high, and they are hooked over the rims of tumblers or highball glasses. They prove to be a special convenience when a party is being served on the lawn or porch



3 FOR AUTOMATIC DEFROSTING just plug in this white enamel box between the electric refrigerator's cord and the wall socket, set the indicator, and forget all about this kitchen chore that many are likely to forget anyway. The electric motor will shut off for an hour or so late every night and then automatically turn on again



4 TARNISH IS RETARDED and silverware kept bright by applying a clear liquid now on the market, after the articles have been cleaned with silver polish. Let it dry an hour, then rub the coating (which isn't a lacquer) lightly with a soft cloth, and the shine will last a considerable time. Soap and water will remove the coating

5 SOUP HERBS GROW IN THE KITCHEN in a flowerpot which puts the city dweller on a footing with his cousin who has a patch of land. Just reach out and pluck chervil, parsley, sweet basil, winter savory, or thyme—it's fresh in your miniature and decorative garden. These are the five herbs now made available as potted plants



for the Household

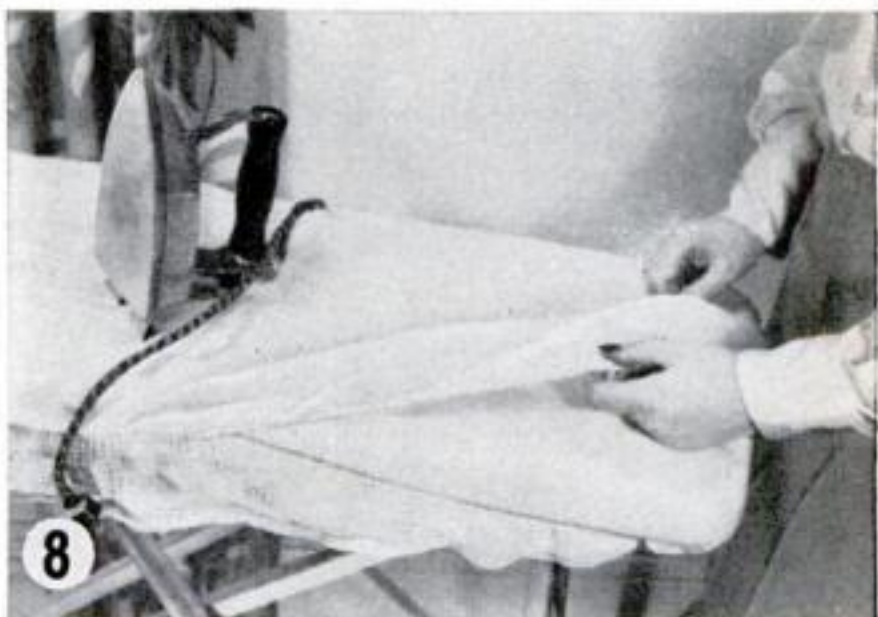
6 DAMPEN LAUNDRY FOR IRONING and still keep your fingers dry with this new type of sponge constructed of two kinds of rubber. The underpart is extremely porous and will absorb water instantly; the upper—that which is held in the hand—is hard and waterproof. The sponge is about 4" in length and comes finished in white



7 TEA AND GREASE STRAINERS OF PAPER strain finer and clearer than wire mesh and will not break under boiling liquids. They are cleaned by turning upside down and flushing with water. Filters, held on by an elastic band, are detachable for replacing. They are available in all standard sizes, 2½" in diameter and larger

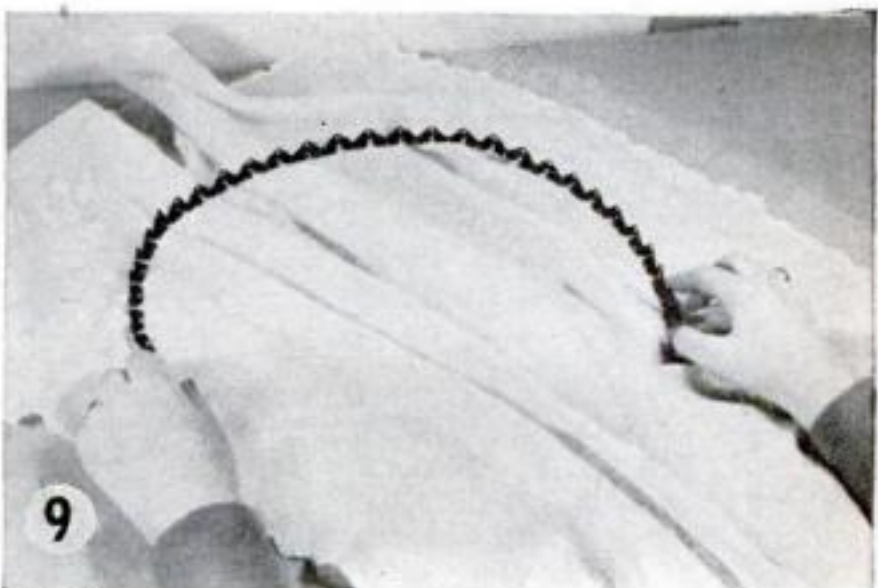


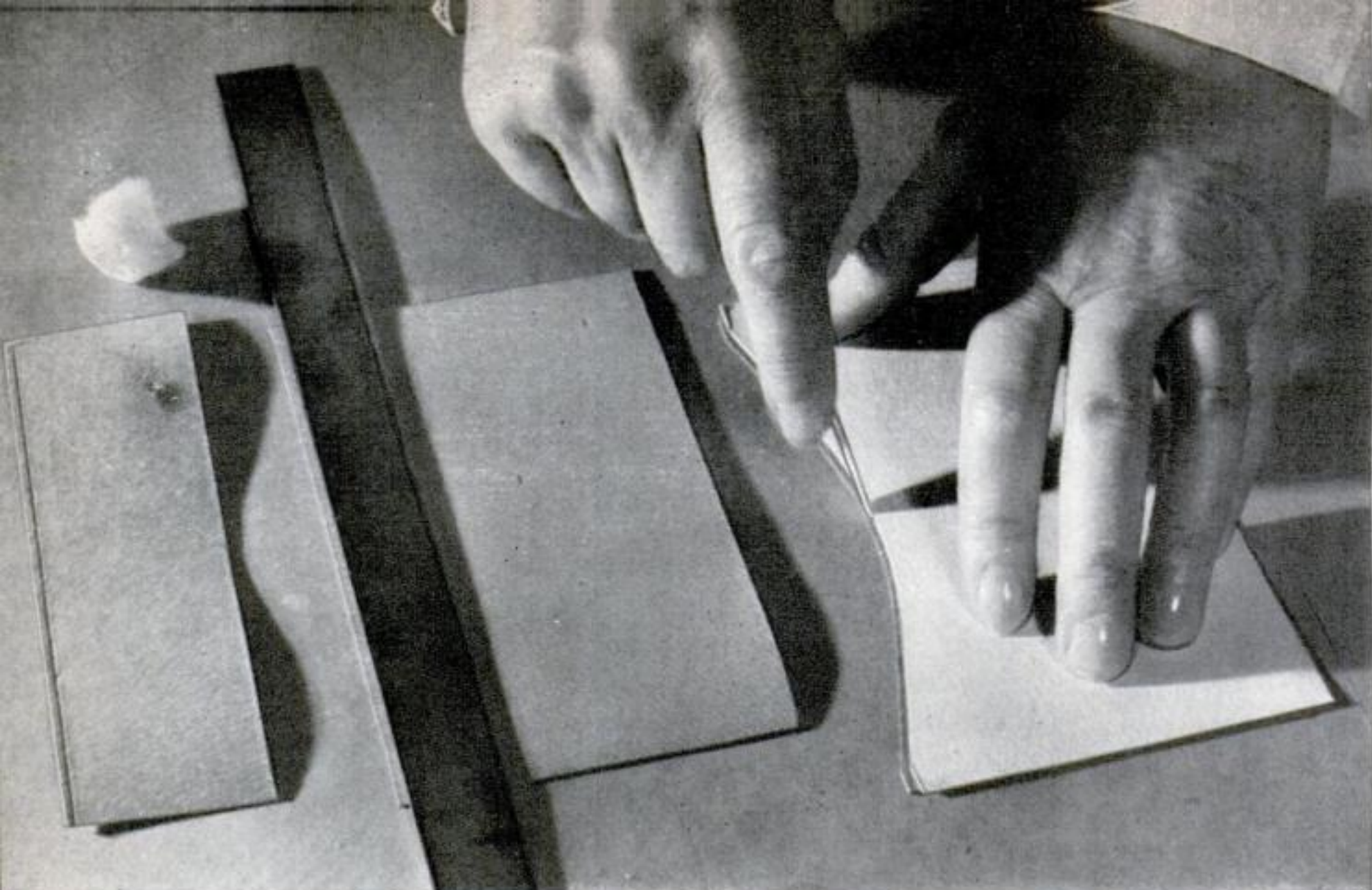
8 SLIP-ON IRONING-BOARD COVERS, made of vegetable fiber, are pliable, absorbent, soft, free of lint, as well as insoluble even in live steam. Fabrics ironed on them are said to have a smoother finish. Covers come in various sizes to fit 12" by 48", 13" by 54", and 15" by 54" boards, as well as for use on sleeve boards



9 DRAPES FOR ODD-SHAPED WINDOWS or for round or square pillars can be hung on this pliable metal strip. The base, which contains holes for mounting, is at 90 deg. to the top, in which are eyelets for attaching drapery hooks. To install, bend to desired shape, cut to length with ordinary shears, and screw or tack the rod in place

10 RIPPLED PLASTIC VASES constructed of a thin sheet of transparent material add a new note to table and flower arrangements. Breakage resistance is high, and the manufacturer has used ingenuity in the design and selection of colors to achieve beauty. Rippled plastic dishes for serving candy and nuts can also be obtained





When marking or tooling straight lines on leather, always use a straightedge. In laying out curves, as is being done in this photograph, a tin or cardboard template is useful for guiding the marking tool.

Leather Craft

LEATHER craft is a hobby that is at once entertaining, useful, and profitable. It requires few tools and is comparatively inexpensive, yet the completed projects, when well designed and carefully executed, are

valuable. They make excellent presents.

If you learn the basic processes used in decorative leather work, you will find it easy to apply them to a great variety of articles. In doing this, you will have an almost unlimited opportunity to exercise your creative ability, and that always doubles the pleasure derived from a hobby.

The accompanying "data cards" are the first four of a series prepared by Raymond Cherry, professor of industrial arts, State Teachers College, Wayne, Neb. The complete set will cover all the fundamental operations in leather craftwork.

CRAFT LEATHERS

[LEATHER CRAFT—1]

Leather in many colors may be purchased from leather companies by whole or half skins, or by the square foot or square inch. Dealers will also cut leather from your pattern, and some of them furnish project kits of their own design. If much leather is used, it is more economical to buy whole or half skins.

The best tooling leather is calfskin, but tooling steerhide also works well. Considering economy rather than durability, tooling sheepskin may be used. Calfskin makes excellent billfolds, ladies' purses, coin purses, cigarette and comb cases. Tooling steerhide makes durable billfolds, key and card cases, book ends, notebooks. Tooling sheepskin is used for book covers, book

marks, card-table covers. Pigskin may be tooled in straight lines for letter cases, key cases, coin purses.

Embossed leathers have designs impressed upon them. Embossed steerhide and cowhide are used for brief cases, notebooks, camera cases. Sheepskin is sold with fancy embossed designs or imitation grains of expensive leathers, such as ostrich, and is used for coin purses, book covers, billfolds. Suèdes are used for linings, handbags, belts. Reptile leathers are used for billfolds, coin purses, handbags. Ostrich is used for billfolds, coin purses, book covers. Heavy steerhide, cowhide, and elkhide are used for belts, knife sheaths, moccasins. "Skiver" is thin leather used only for linings.

MAKING DESIGNS and PATTERNS [LEATHER CRAFT-2]

Before the leather is cut, it is necessary to prepare a full-sized pattern of heavy paper. If the finished article folds, the pattern also must be folded. On this pattern place the design for tooling, if any. The design may be original or copied from design books or other sources. Ideas may also be obtained by observing the finished leather articles shown in catalogues and shop windows.

Blue-lined cross-section paper with $\frac{1}{4}$ " squares will aid in developing original designs. One's first attempt at tooling should be done with a simple design largely of straight lines.

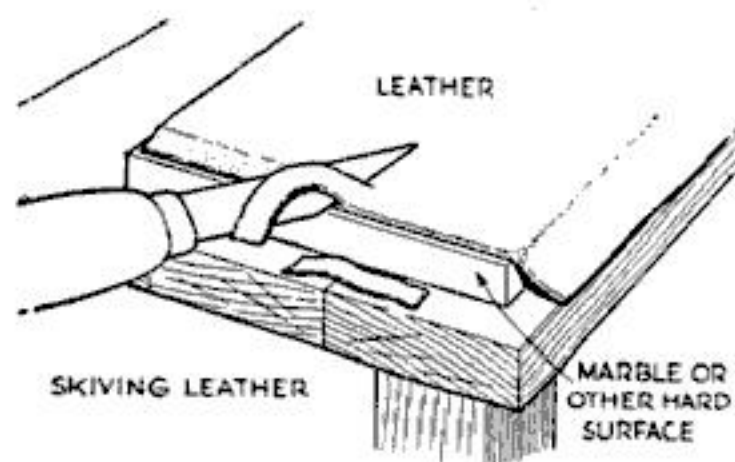
Do not try to decorate the entire article. Remember that you must make allowance on the pattern for laced edges, folds, and fasteners. Check the pattern and design to see that they are correct before you cut out the leather and transfer the design.

Permanent templates or patterns may be made from tin if a number of identical articles are to be made. They are a great help in laying out and cutting leather. Label them plainly to avoid possible errors in identifying and using them, and preserve them for reference in case duplicate projects have to be made.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

LAYING OUT and CUTTING

[LEATHER CRAFT-3]



The best quality of leather for tooling comes from the backs of animals. Use a steel square and chalk to lay out lines on the grain or finished side of dark-colored leather, and a pencil

on leather which is light in color.

Place the leather on a cutting board. Hold the steel square or tin template on the layout lines. Use a sharp knife to cut all straight edges. Hold the blade at a 45-deg. angle and cut through the leather on the first stroke. Curves may be cut with tin snips. Do not cut past corners.

When two or more pieces of leather are to be joined, the edges must be thinned so that the assembled edges are no thicker than the original leather. This is called "skiving." A thin slice is cut from the unfinished side as shown.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

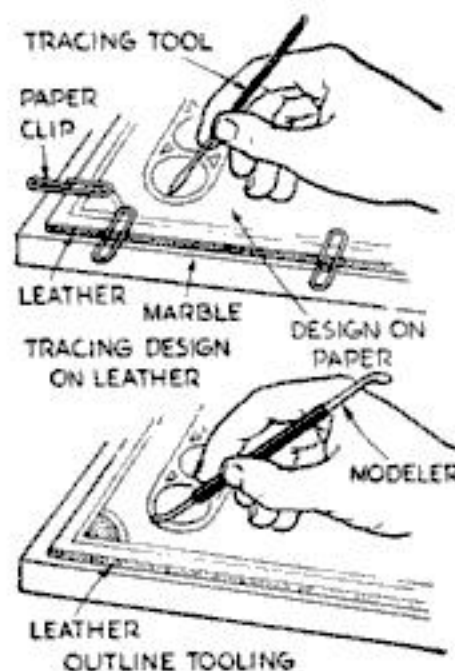
OUTLINE TOOLING

[LEATHER CRAFT-4]

To make tooling leather pliable, moisten the entire unfinished side until the finished side darkens. Then fasten the pattern with the design to the finished side by using paper clips. Place the leather on some smooth, hard surface, such as marble.

Trace the design with a leather-tracing tool held as a pencil. Use a straightedge to mark straight lines. Raise one end of the pattern to see that the design is clearly outlined on the leather. Remove the pattern.

Go over the design several times with a leather modeler until all lines are uniformly depressed. Always use the straightedge to tool straight lines. Work from the outer edges toward the center on all lines to avoid stretching the leather. Leather is too wet for tooling if water oozes up back of the modeler. After tooling has been completed, place the leather in the position desired until it dries.



POPULAR SCIENCE MONTHLY SHOP DATA FILE

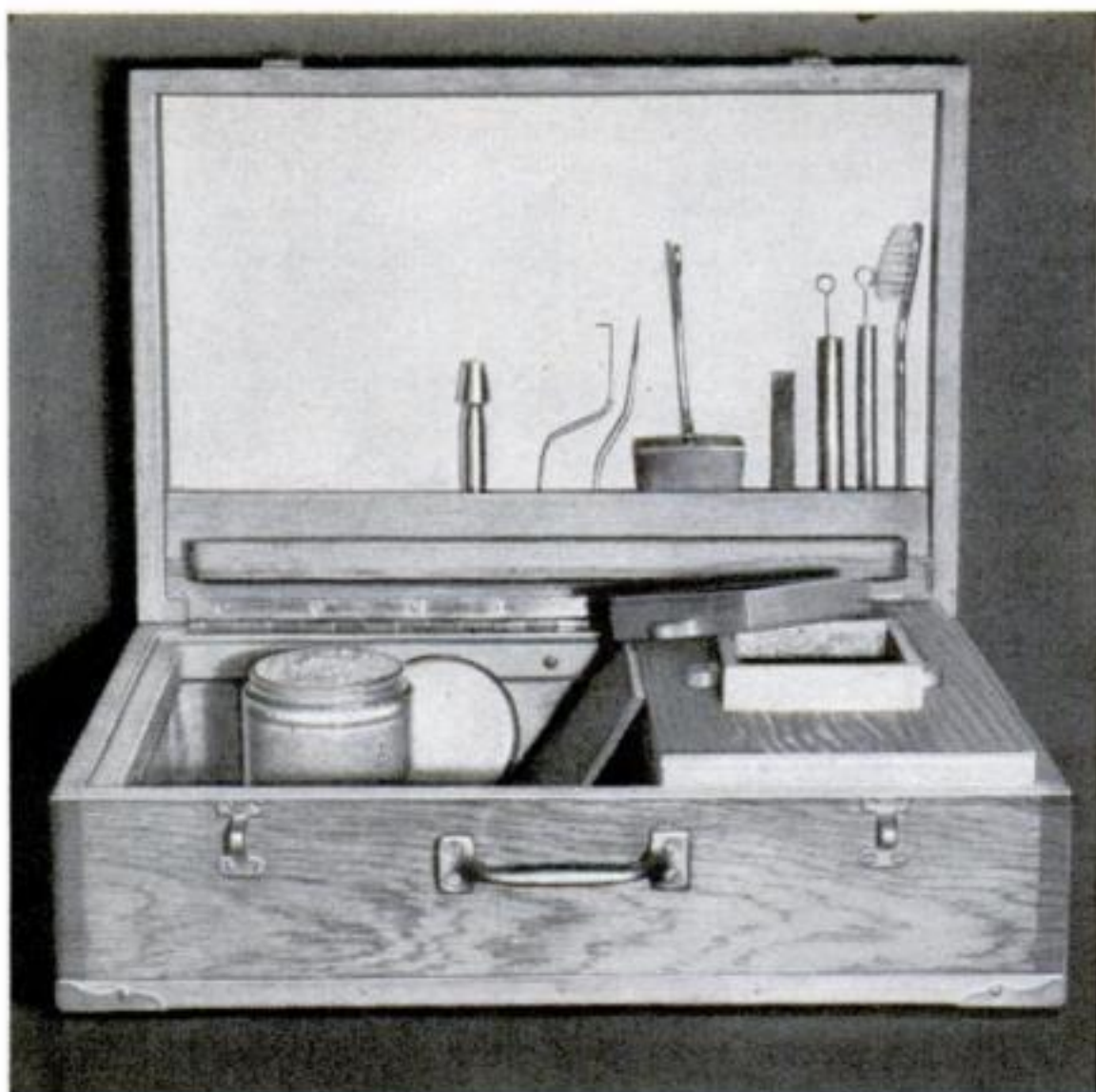
Art-Metal Foundry

COMPACT UNIT
ENABLES ANYONE
TO CAST SMALL
GIFTS, NOVELTIES,
AND MODEL PARTS

By H. John Blann
and Tom E. Moore

CASTING small objects in soft metals becomes a simple task in the home workshop for anyone who will take the time to construct this compact little art-metal foundry. It makes possible the casting of a variety of ornaments, buttons, costume jewelry, toys, and small parts for models.

A unique feature of the outfit is the fact that the casting is done in FFF pumice stone and glycerin mixed in an 8:1 ratio by volume. This takes the place of the usual foundry sand. It is extremely accurate for fine-detail casting, and has two other definite advantages over the regular



The complete miniature foundry outfit, including the molding board and flask, packs neatly into a metal-lined carrying box

sand—first, it requires no parting sand, but breaks cleanly from the pattern and from itself; second, it requires no tempering with water as does sand, hence, no steam pits occur in the castings, and there is no time lost waiting until sand that is too wet has dried sufficiently for use.

The pumice and glycerin may be mixed

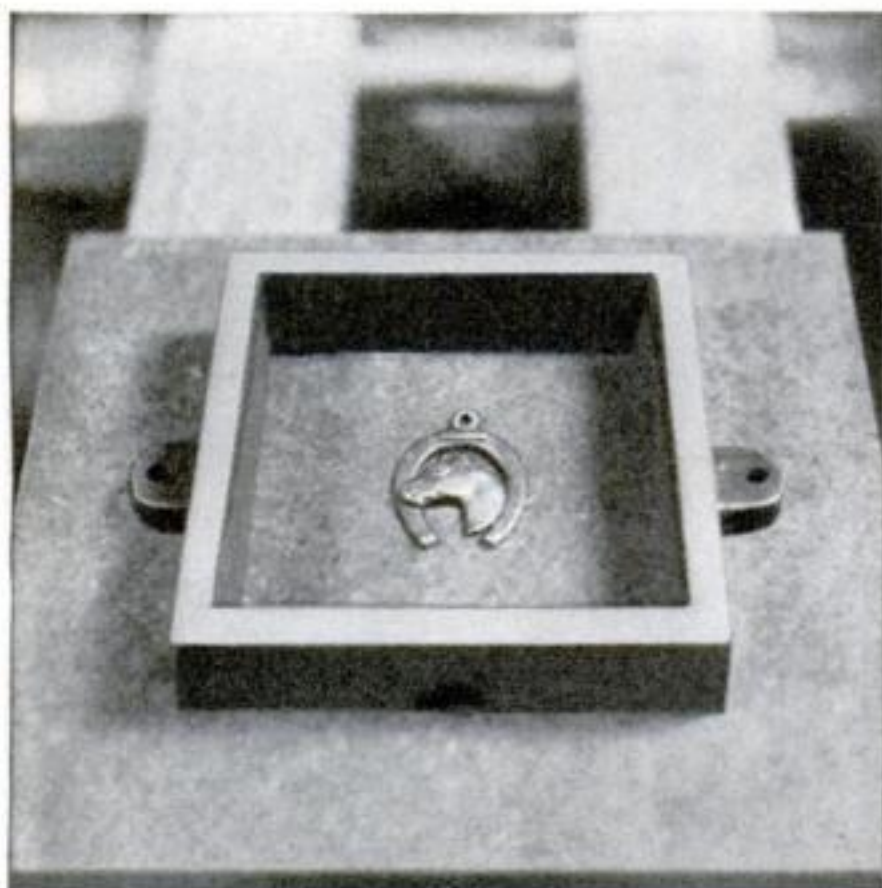


Fig. 1. The pattern of the object to be cast is placed face up on the molding board, and the drag is inverted over it. The process is a modified version of that employed in regular foundry work



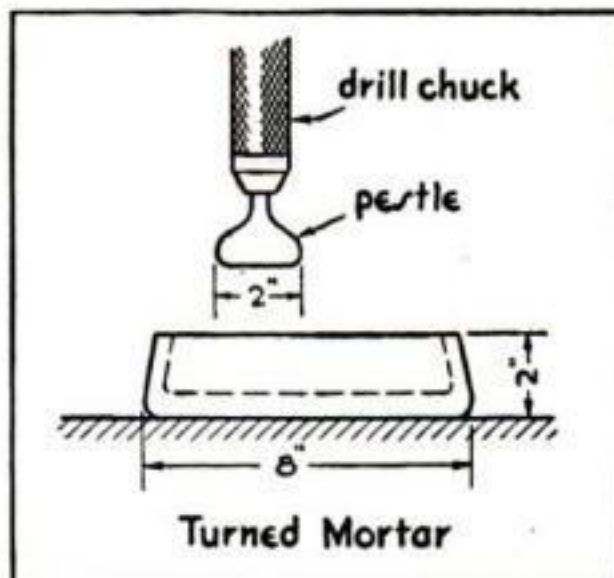
Fig. 2. Molding sand is packed into the inverted drag and rammed down. A unique "sand" mixture of pumice-stone powder and glycerin, well suited for fine-detail casting, is used in this process

with a mortar and pestle either by hand or in a specially constructed set to be used in a drill press. Turned from hardwood, the mortar is approximately 8" in diameter and 1½" deep; the pestle is made about 2" in diameter, with a neck small enough to be clamped lightly in a drill-press chuck. Still another way is to mix the pumice and glycerin first with enough water to make a thick paste, then evaporate the water by heating this paste in a shallow pan. If the water is not entirely removed, however, steam pits will appear in all castings, and one of the advantages of the mixture will be lost.

The mixture is kept in an air-tight jar when not in use to prevent absorption of water from the air. The "sand" can be used over and over again, but in time the edges of the grains will become round, thereby losing "tooth." When this occurs, the pumice and glycerin mixture should be replaced.

The box in which the foundry and foundry tools are kept is made in the form of a carrying case. A block of wood is provided to hold the foundry tools, and there is a ledge to support a molding board.

This ledge is undercut with a narrow saw kerf on the underside to incase completely



The mortar and pestle used to mix pumice stone and glycerin are made of hardwood. They are turned in the lathe to the dimensions indicated

the metal lining for the bottom of the box. The lining is of bright tin plate or 22-gauge galvanized iron.

The miniature foundry tools are made from odds and ends. The pattern for the flask is constructed from small pieces of pine or mahogany and finished with two coats of orange shellac. The flask castings may be made at home or obtained from a local foundry at nominal cost. If the castings are to be obtained from a foundry, it will be well to have them made from

bronze or cast iron for maximum durability.

Slicks are forged from valve springs, following the pattern of regular foundry slicks. The ladle may be purchased at a hardware store. The sprue cutter is a piece of ¾" brass tubing. It is turned on a lathe on one end so that the interior is cut away to a sharp edge, as shown in the drawing.

The rammer is turned from hardwood, such as maple or birch, or it may be made from cold-rolled steel, brass, or aluminum. Galvanized iron is used for the shovel, which is cut to the pattern given in the drawings, then folded, soldered in the corners, and fitted with a bent wire handle. The handle is riveted on. The molding board is a scrap of five-ply fir, 6" by 10",



Fig. 3. Superfluous sand is next struck from the top of the packed drag, and the drag turned over on the molding board. A slick is used to remove excess sand above the parting line of the pattern



Fig. 4. The cope is placed on top of the drag. Sand is packed into it and rammed, and the excess struck off. Next, the two parts of the flask are separated so that a sprue can be cut for pouring

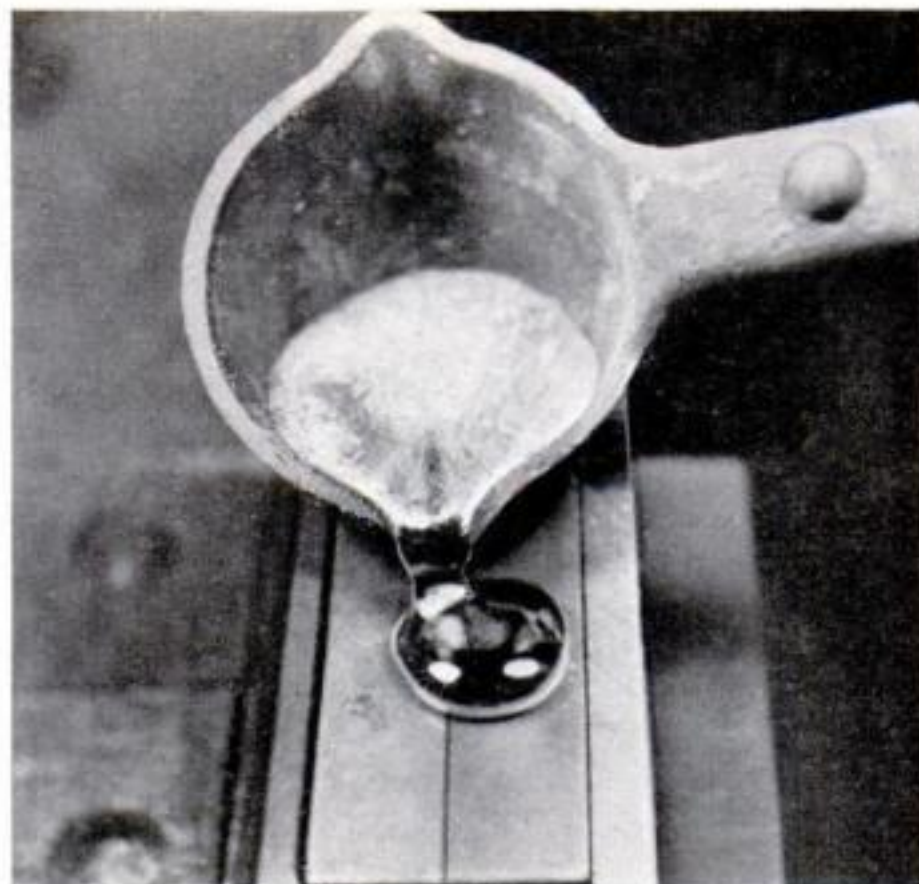
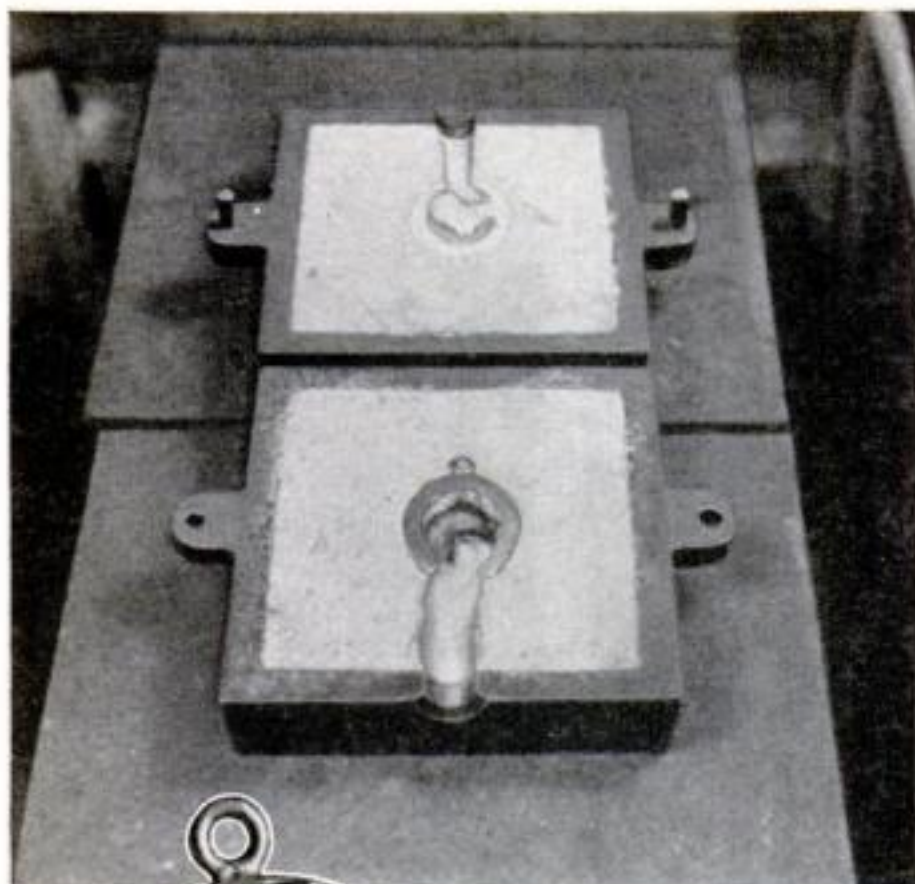


Fig. 5 (left above). The pouring sprue is cut in both parts of the mold. The pattern is then gently removed. Fig. 6 (right above). Reassembled, the flask is placed in a vise for pouring. The finished casting appears at left

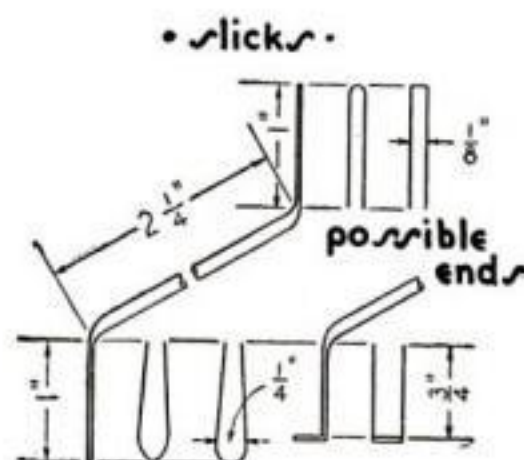
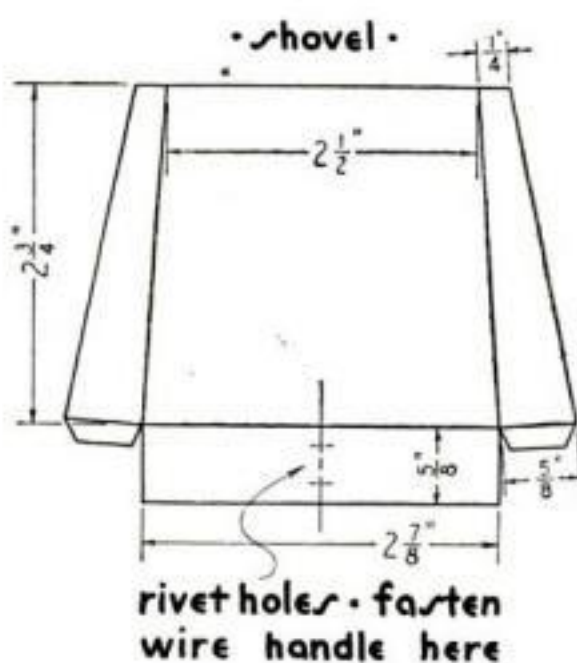
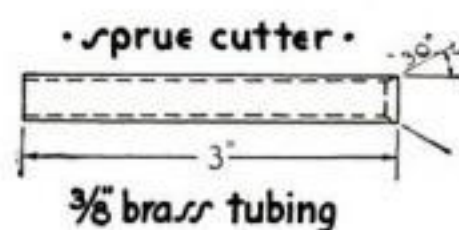
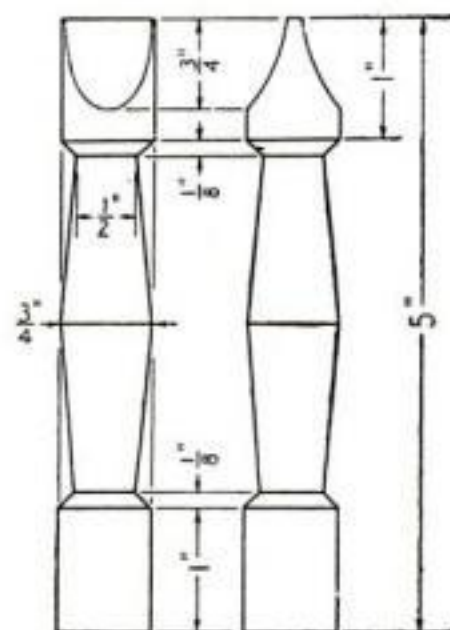
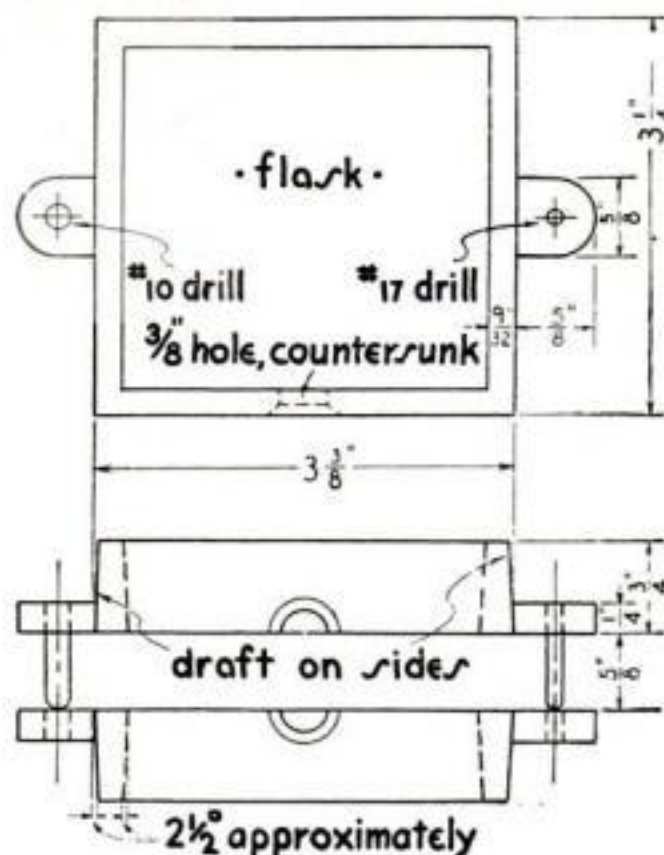


or of pressed wood of the same size.

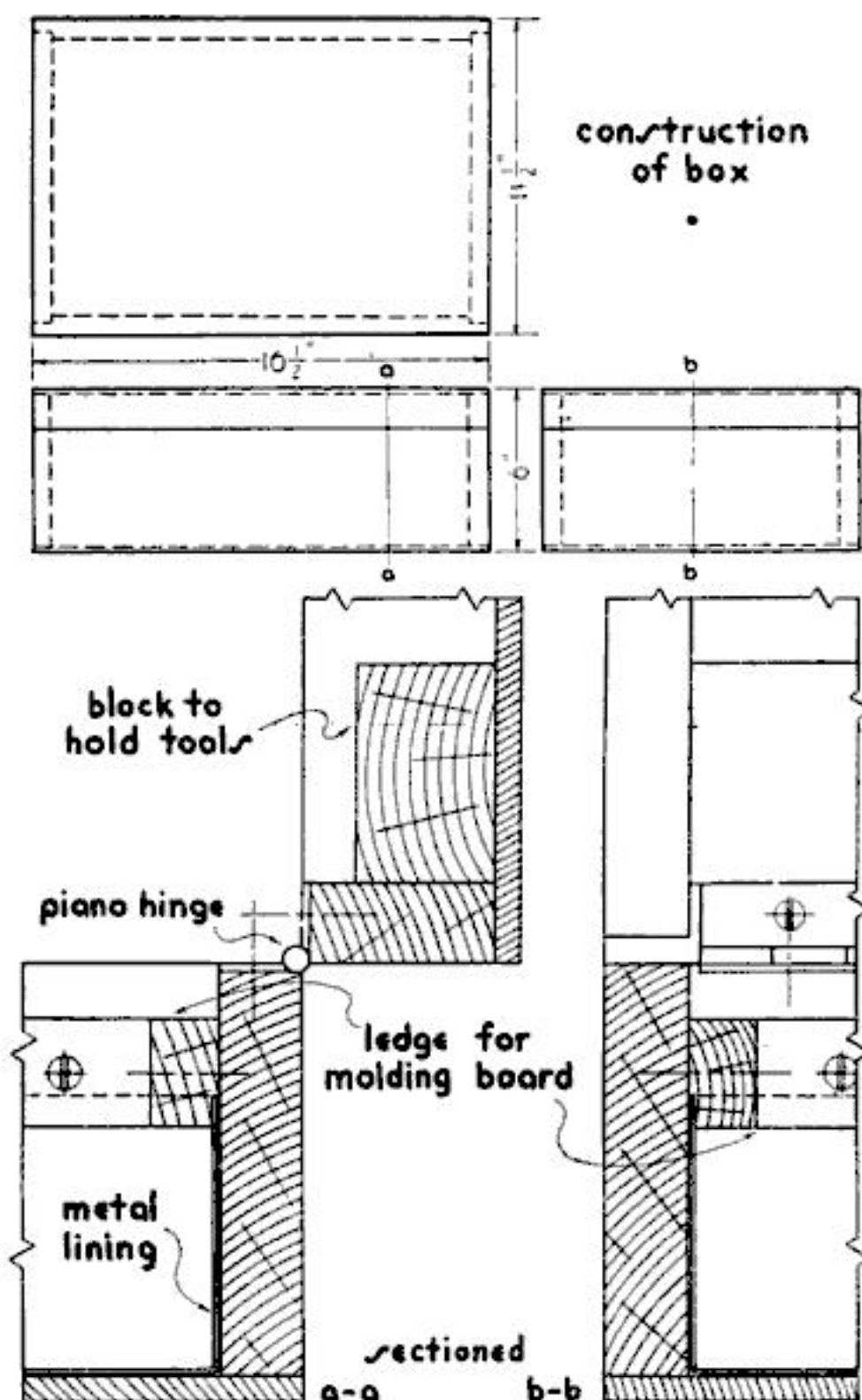
Metals for casting include lead, tin, pewter, type metal, and die-casting metal. If a cast-iron flask is used, brass, bronze, copper, and other metals which melt at higher temperatures may be used provided that facilities are available for melting them.

The process of art-metal casting is a miniature version of regular foundry work. The steps are shown in the accompanying illustrations. The model or pattern in this instance is a horse-head medallion.

In Fig. 1 the pattern has been placed face up on the molding board, and the drag inverted over it. The pumice is packed into the inverted drag, and is rammed tight as in Fig. 2. Superfluous "sand" is struck from the top of the drag, and the drag is turned over. A slick is then used to remove



Above, left, is design for flask, showing pouring hole in one edge. To its right is sketch for rammer; below, the shovel, sprue cutter, and slicks. The miniature foundry tools are made from odds and ends



Box for foundry and tools is lined with galvanized iron or tin, has block for tools, and ledge for molding board

excess "sand" above the parting line of the pattern (Fig. 3).

The cope is placed upon the drag, sand is packed and rammed into it, and the excess is struck off (Fig. 4). The parts of the flask are separated (Fig. 5), and the pouring sprue is cut with the sprue cutter. This sprue extends in both parts of the mold from the pouring hole in the flask to the pattern. Final trimming away of sand is done by use of a slick. The pattern is then gently lifted out and the flask reassembled. A simpler way to remove the pattern is to turn the drag upside down and let it drop out of its own weight.

The flask is sandwiched between two pieces of pressed wood. It is then held securely in a vise, with the pouring sprue up. Molten metal is poured in carefully until it runs over the edges (Fig. 6). This is an unconventional method, but gives satisfactory results.

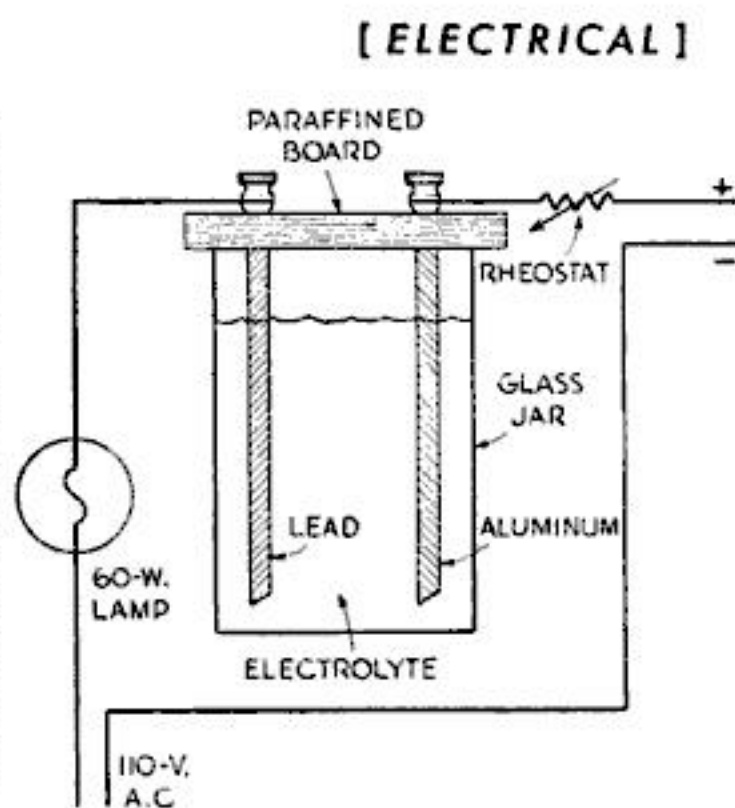
When the metal has cooled until it is no longer shiny and the top surface has become hard, the mold can be separated. After it has cooled sufficiently to be handled, the sprue metal can be broken away from the casting. The casting is then cleaned with an old toothbrush, smoothed with jeweler's files, and buffed or polished.

EDITOR'S NOTE: *This special type of work was introduced to hobbyists by Mr. Blann when a senior at the State Normal School, Oswego, New York.*

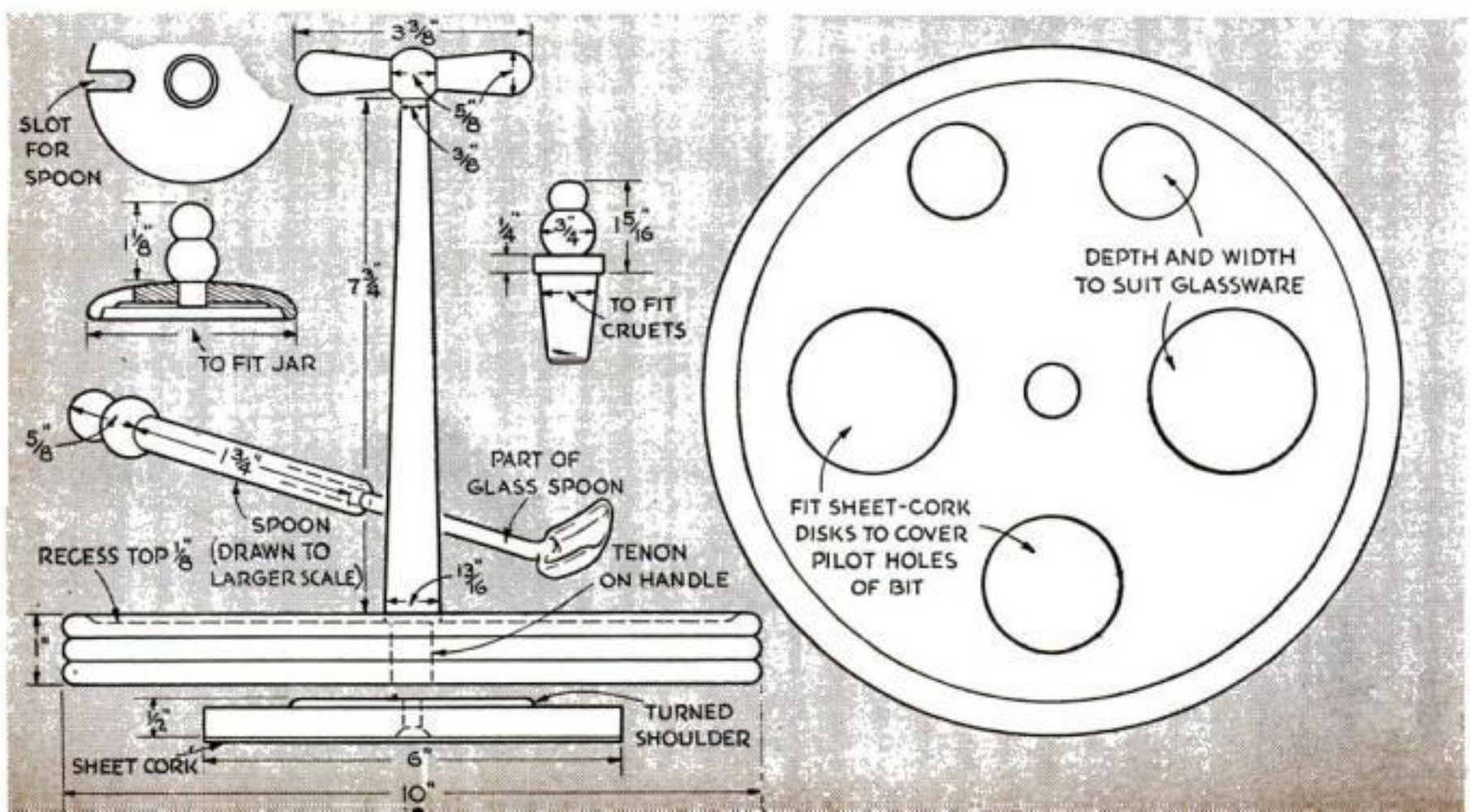
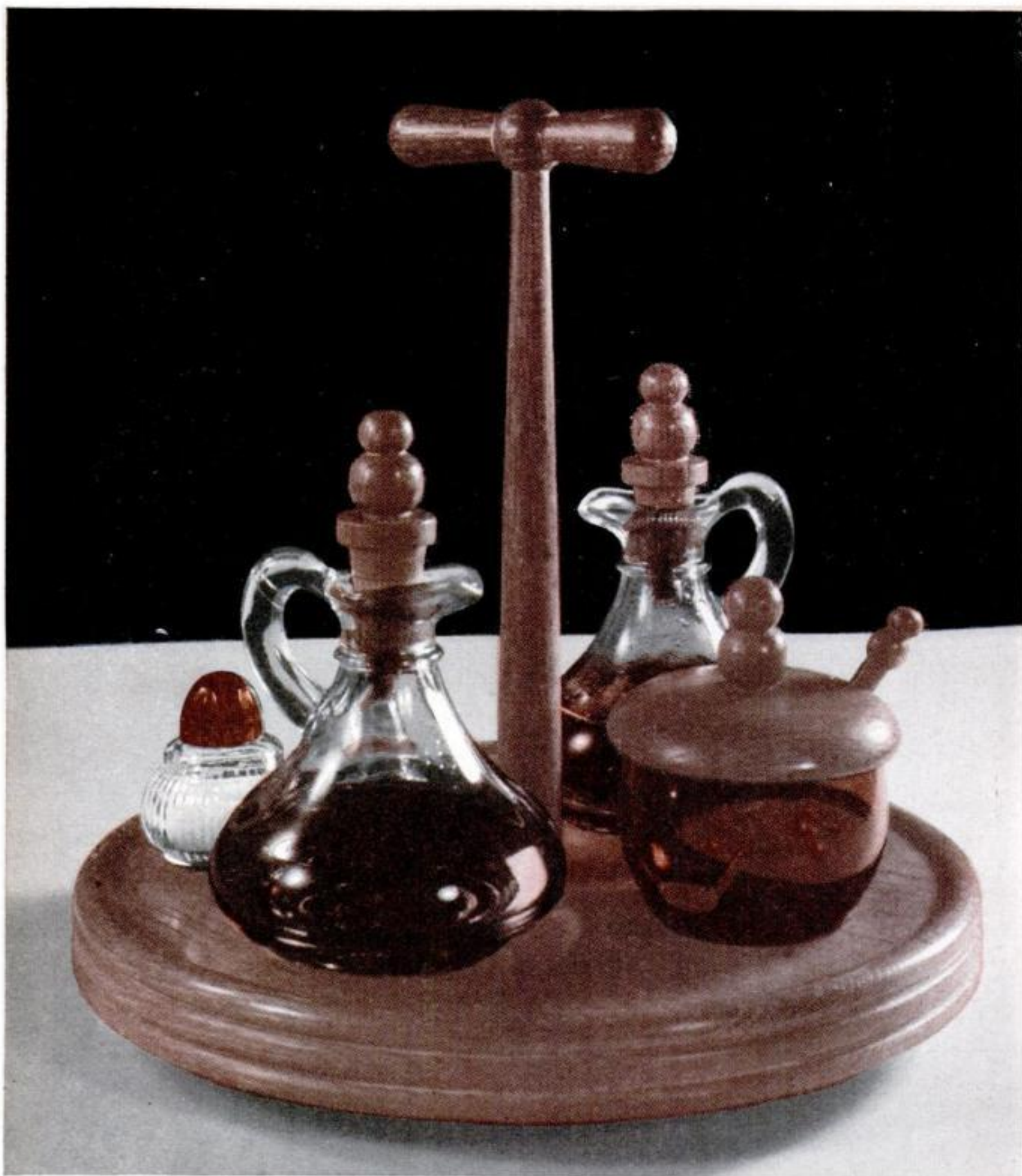
ELECTROPLATING, PART 5

A simple half-wave electrolytic rectifier will supply direct current for electroplating of an experimental nature or when the size of the work is not large. It makes use of the principle that when two metals are immersed in a suitable electrolyte, they will set up a greater resistance to current flowing in one direction than in the other.

A glass container such as a fruit jar, may be used to hold the electrolyte. This may consist of a strong solution of dibasic ammonium phosphate or of ordinary borax. Cover the jar with a piece of wood which has been soaked in hot paraffin. To the underside of the wood, screw a strip of sheet lead and another of aluminum, so that they will be suspended in the electrolyte. The surface area of the strips will determine the amount of current that can be rectified. Connect the rectifier, in series with a 60-watt or larger lamp, to the 110-volt A. C. supply.



POPULAR SCIENCE MONTHLY SHOP DATA FILE



Quickly Made Gift Projects

DESIGNED FOR POPULAR SCIENCE BY ERNEST R. DEWALT

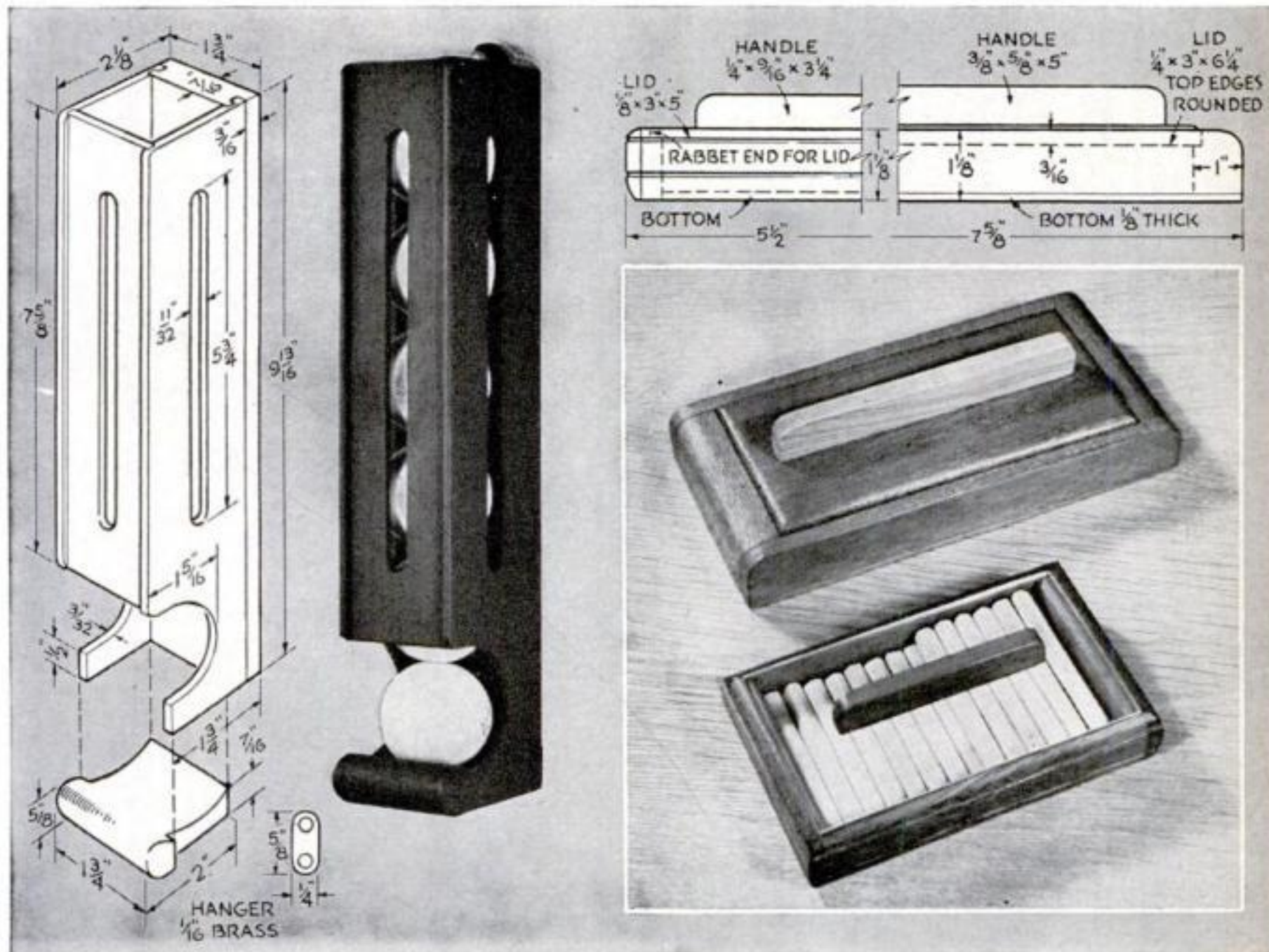
LAZY-SUSAN CONDIMENT SET. Stock glassware is used, the stoppers and the jar cover being individually fitted. The set shown was made of oak, but any good turning stock will serve. Mount a 10" disk, $1\frac{1}{8}$ " thick, on a faceplate for turning the tray. An expansive bit forms the various recesses, into which cork disks are glued. Turn the base and attach it with a single countersunk screw, left loose enough to permit the tray to revolve. Part of a small glass spoon such as is used in tall drinks is cemented into a turned handle to form the mustard ladle.

The wooden parts may be tinted with filler or stain, and finished with three coats of shellac or two sprayed coats of clear lacquer, rubbed, waxed, and polished. Approximate time, 5 hours.

RACK FOR TABLE-TENNIS BALLS. Well-seasoned pine is suitable for this game-room accessory. All rabbeting and grooving are

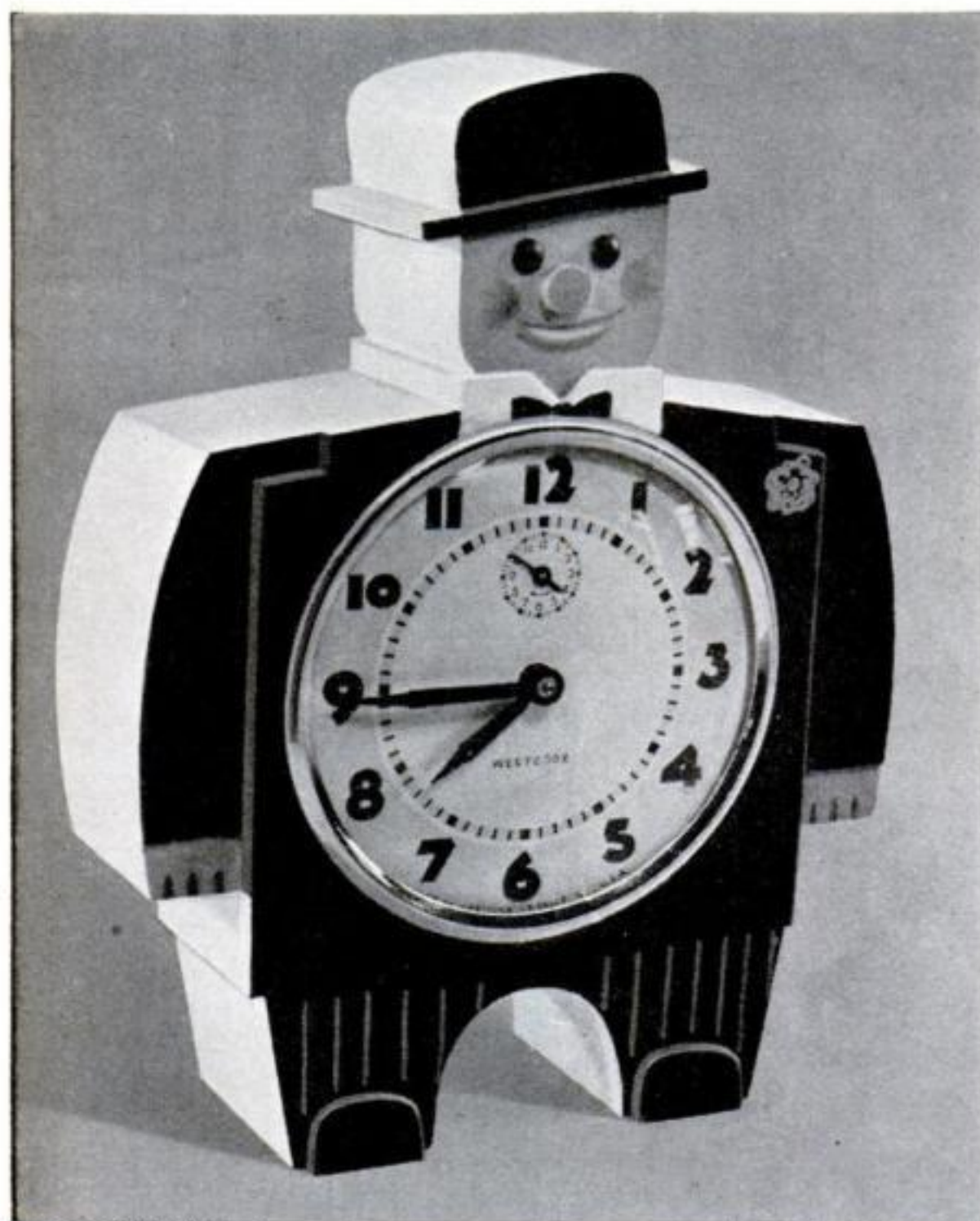
done on the circular saw. The bottom is band-sawed or shaped with a rasp. Glue and clamp together. Attach small metal hangers for mounting. A dull black finish contrasts well with the white balls, of which the rack holds six. Approximate time, $3\frac{1}{2}$ hours.

CIGARETTE OR JEWEL BOXES. If for cigarettes, these boxes should be made the right width to fit your favorite long or standard-size brand. Glue up the sides and bottoms, and sand or plane the boxes to shape after the glue has set. The lid rabbets are cut into the ends or formed by gluing small fitted blocks to the inside faces. Make the decorative grooves on the smaller box by running it over a circular saw set to cut $1/32$ " deep. Lids may be of plastic, glass, or wood. Sand the boxes smooth, apply two coats of clear lacquer, rub down with fine abrasive paper, and finish with wax. Approximate time, $3\frac{1}{2}$ hours each.



Rumpus-Room Clock

DESIGNED BY JUAN OLIVER

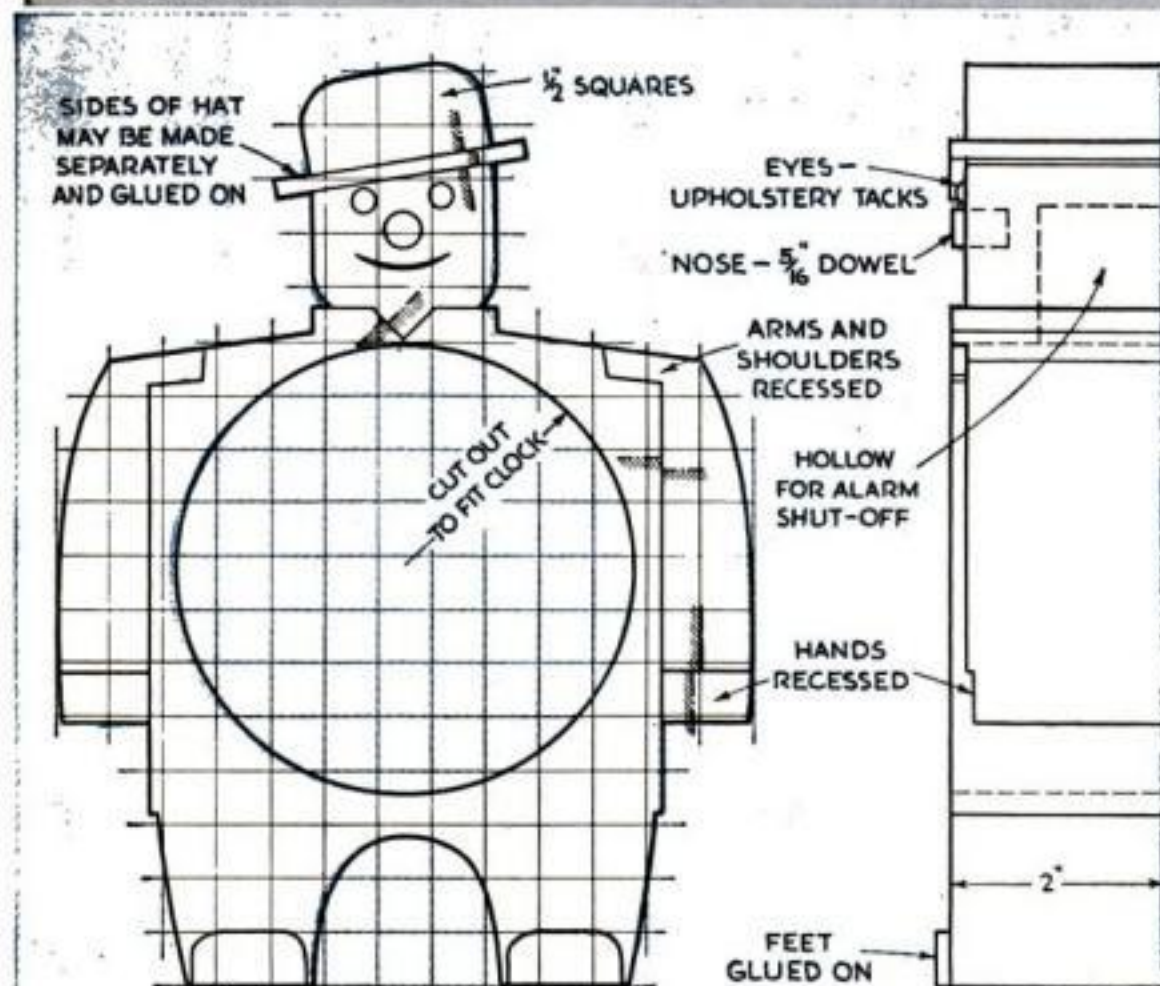


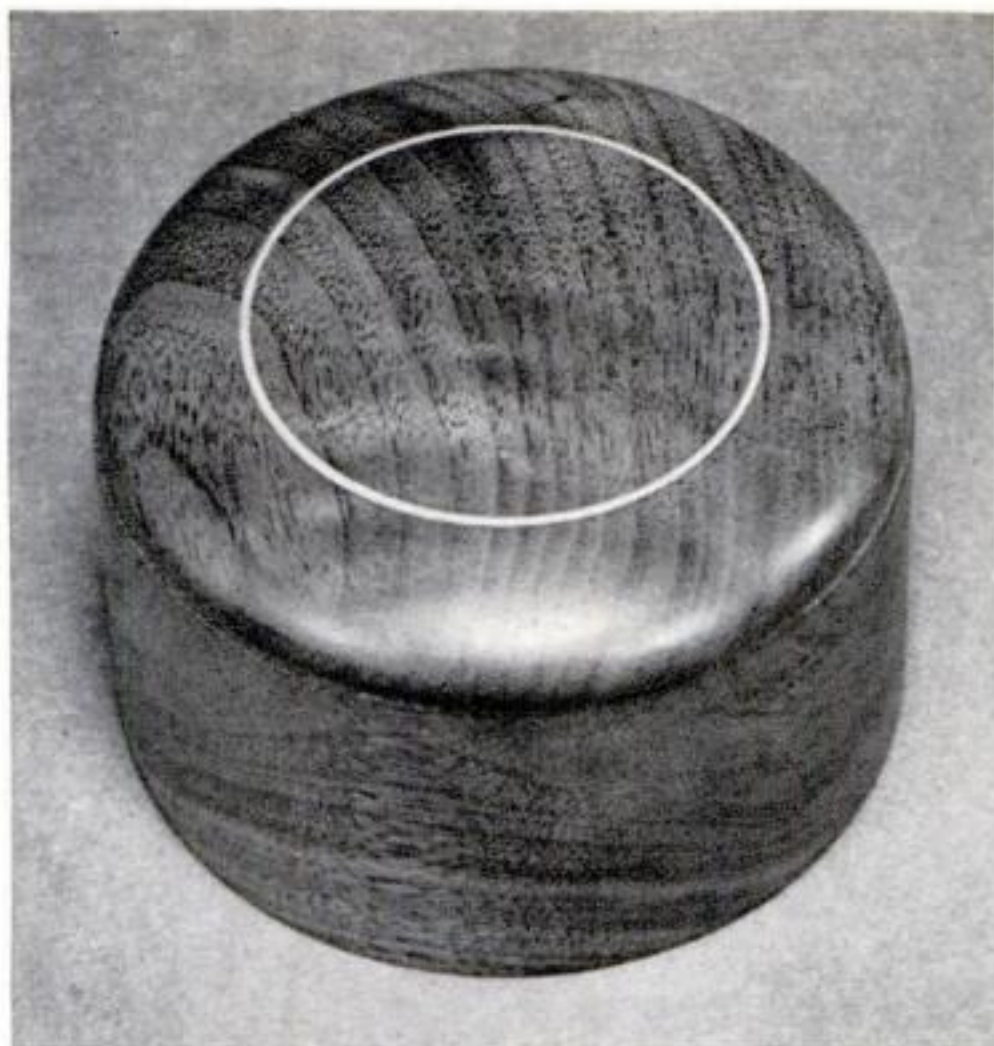
IF THE game room must have a clock—and time is all too likely to pass unnoticed there if none is provided—let it by all means be an amusing one. The smiling gentleman illustrated will tactfully remind you and your guests when it's time to call it a day, and just as cheerfully welcome you back again for hours of fun. He can be kept on the home bar, on one of the shelves behind it, or wherever he will be in plain sight.

White pine will do nicely, and if no 2" thick stock is on hand thinner material can be glued up to that size. Lay out the figure on 1" squares, then saw out the opening for the clock. An electric one is ideal, of course. The base or legs will probably have to be removed. Hollow out the figure from the back, if necessary, for any projecting parts.

Band-saw or otherwise cut out the body, making certain that the feet are flat and square so that the figure will stand firmly. With a sharp chisel, cut back the face, the hat above the brim, and the arms and shoulders about $\frac{1}{8}$ ". The hands are further recessed about $\frac{1}{16}$ ". Insert the nose and eyes. Make a shallow cut for the mouth, and glue on the small blocks at the feet.

After sanding smooth all over, apply two thin coats of shellac, sanding lightly again after each. Paint as in the photograph, or with stripes or checks if an even more comical effect is wanted. The *boutonnière*, tie, and fingers are simply painted on. Approximate working time, 3 hours.





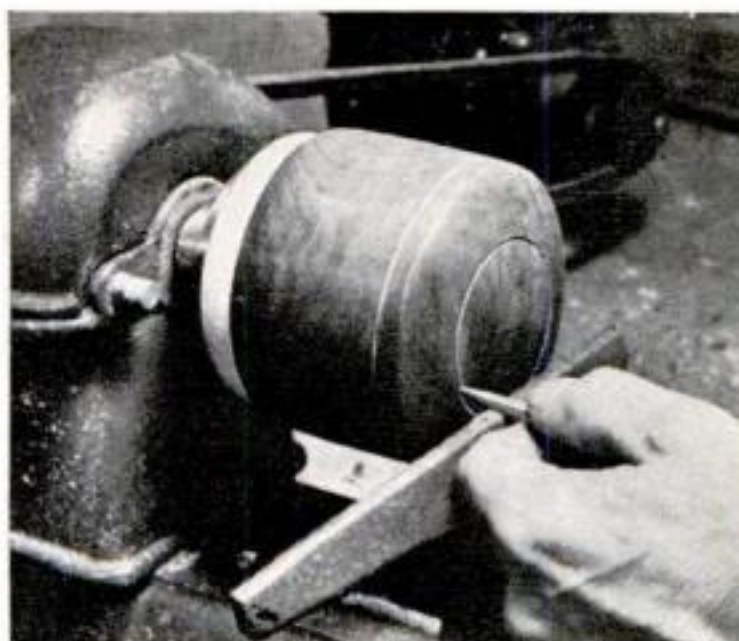
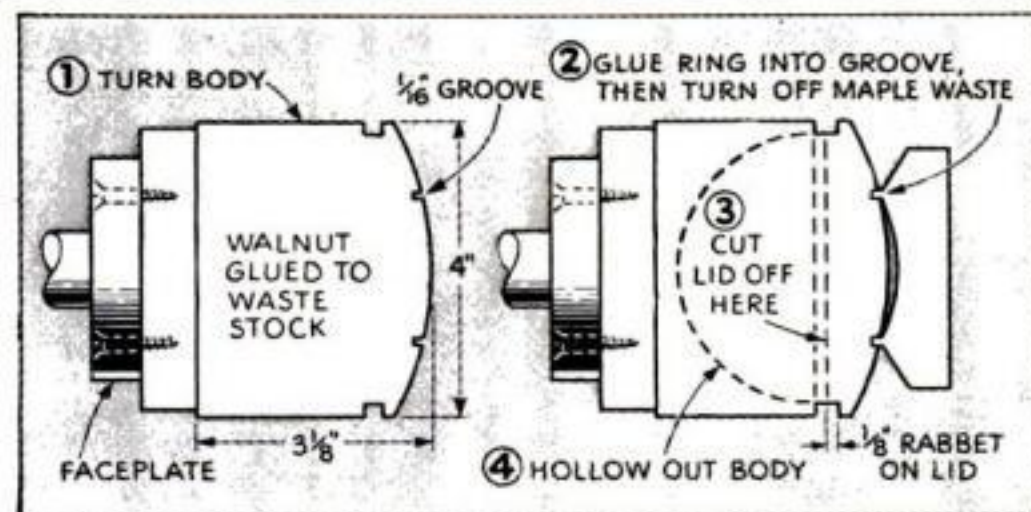
Inlaid Ring of Maple Ornaments Turned Walnut Powder Bowl

A LATHE-TURNED inlay decorates this powder or trinket bowl. Select a block of walnut of sufficient thickness to permit turning both the lid and the bowl. Glue it to waste stock with paper between, and mount on the lathe faceplate. Shape the front and smooth off. With a parting tool having a point $\frac{1}{16}$ " wide—it can be made from the tang of a file—cut a groove $\frac{1}{16}$ " deep in the face. Remove from the lathe.

Now mount a small maple block on a faceplate and turn a ring the size of the groove, fill the groove with glue, and force the ring into it. When the glue has dried, remount in the lathe and cut the maple block off with the parting tool.

Rub wood filler on the work and let it dry. Apply shellac. While wet, hold a cloth, moistened with shellac, alcohol, and a few drops of oil, against the lid and run the lathe at moderate speed for a hard, dry finish. Then turn the lid off, leaving $\frac{1}{8}$ " on the underside to fit into the bowl.

Turn out and finish the inside of the bowl. Glue felt to the bottom.—BENJAMIN NIELSEN.



Groove is cut $\frac{1}{16}$ " deep in face of block



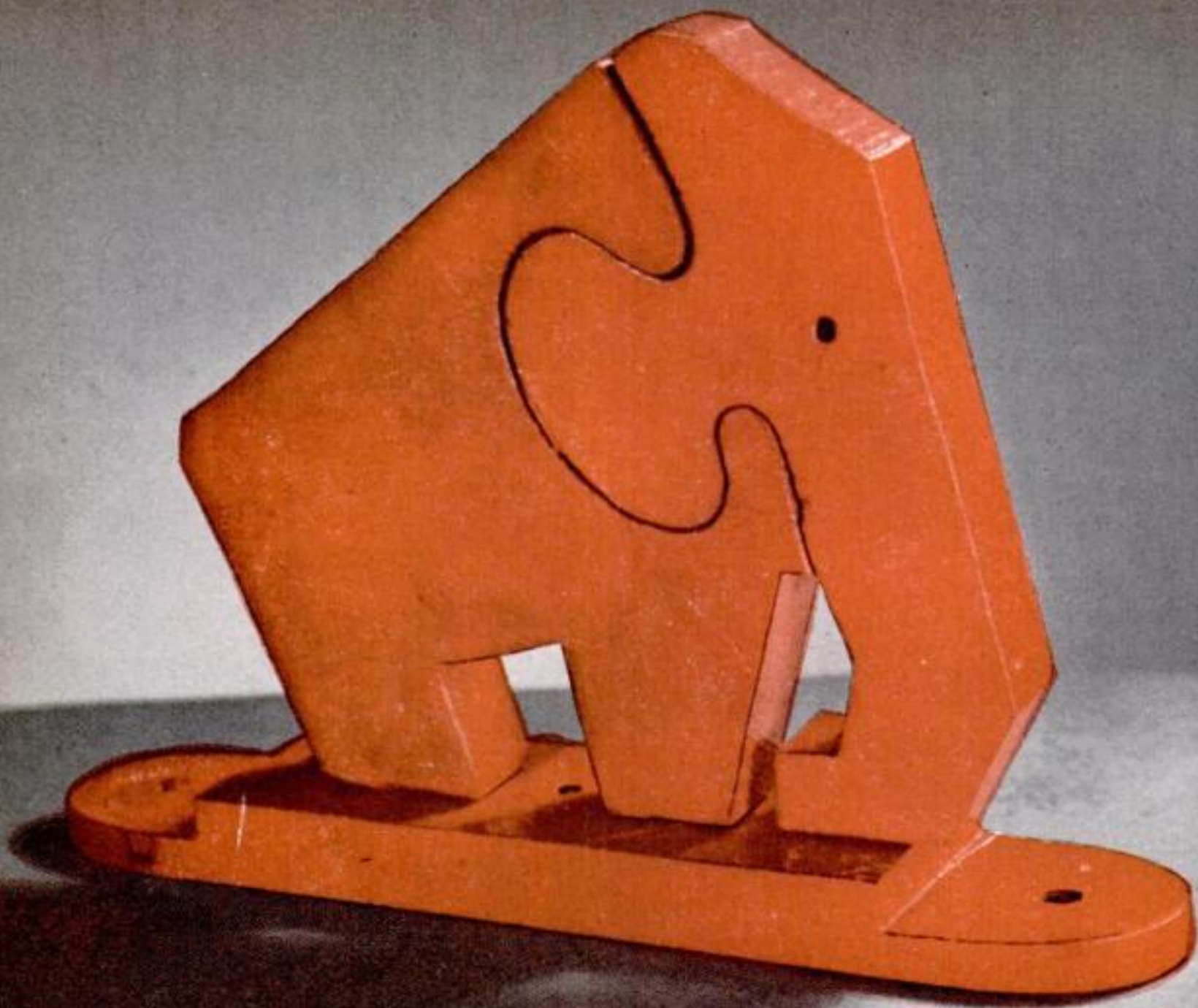
Maple ring turned $\frac{1}{16}$ " for bowl-lid inlay



Ring ready for gluing into groove in block



Work is remounted and maple block cut off



JIG-SAWED MENAGERIE

TEACHES CHILDREN TO MATCH COLORS AND SHAPES

By Phoebe Knight

A SET of these colorful cut-out animals will keep young minds and hands happily occupied for many hours. Putting the figures together teaches a child to discriminate between colors, to fit matching shapes, and, in conjunction with picture books, to recognize the various animals represented. It also develops his creative instinct, and rewards him with a sense of accomplishment—factors today recognized as essential to proper development.

The figures can be cut on a band or jig saw. Lay out the patterns on $\frac{3}{4}$ " plywood by means of $\frac{1}{2}$ " squares, as in the accompanying drawings. The arrangement shown makes it possible to cut all twelve from a 12" by 24" sheet.

The scroll cuts that enable the figures to be taken apart need not be precisely as shown, but can be free-hand. Keep them smooth, however, and avoid sharp corners.

Bases are of $\frac{3}{4}$ " white pine, maple, or other available wood. The end rabbets are slightly deeper than half the thickness of the stock, and can be made on a jointer,

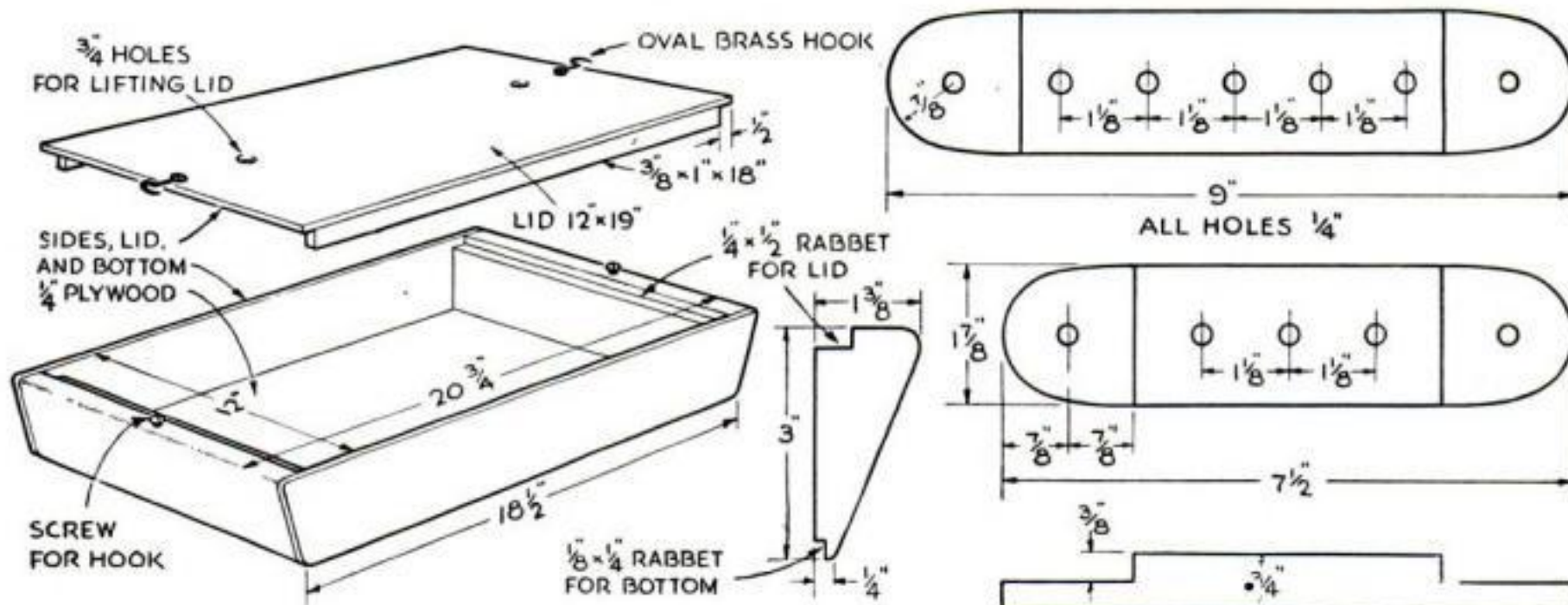
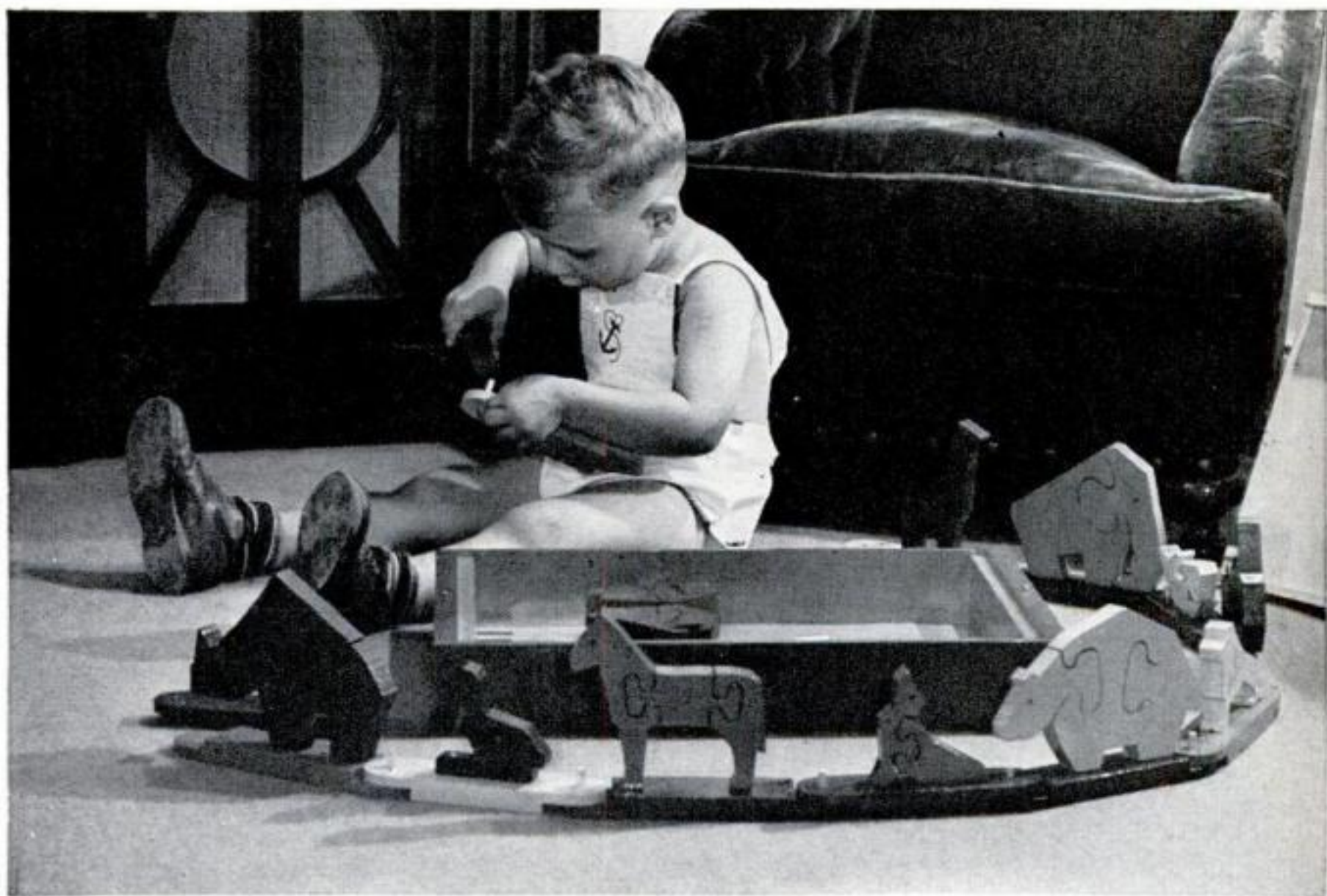
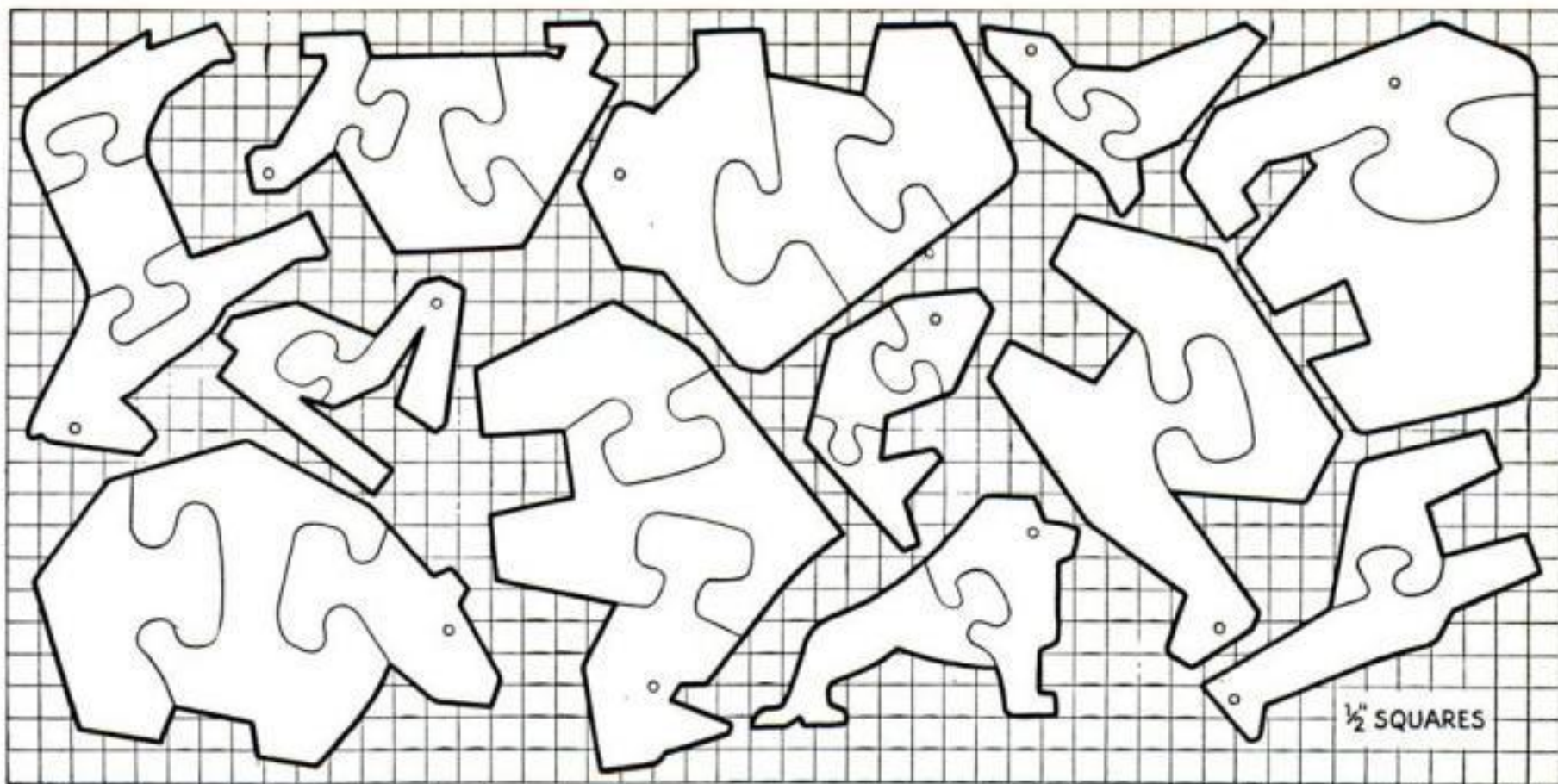
band saw, or circular saw. A disk or belt sander will quickly round the ends, leaving them smooth for finishing. Locate the holes in these ends accurately so that the bases may be joined interchangeably. Into each base drill three, four, or five $\frac{1}{4}$ " holes, accurately spaced $1\frac{1}{8}$ " apart. A strip of tin with five punch marks makes a convenient template for marking their locations.

Assemble each figure temporarily and drill two $\frac{1}{4}$ " holes $1\frac{1}{8}$ ", $2\frac{1}{4}$ ", or $3\frac{1}{8}$ " apart—according to the size of the animal—into the bottom edge. This permits mounting the smaller figures on any base.

The pegs are $1\frac{1}{4}$ " long pieces of $\frac{1}{4}$ " maple doweling, sanded smooth to an easy fit in the holes, then waxed and polished. Cut plenty so that you can replace lost ones. Leaving them loose affords the child another interesting problem.

The entire set of figures can be kept neatly in a box built as shown.

Sand all the animal parts well to remove splinters. Paint them and the bases in four or more colors, such as bright red, green, blue, and yellow, finishing all edges. Be sure to use *nonpoisonous*, washable enamel.



DANNY DRAKE

HOLDS PLACE CARDS IN HIS BILL



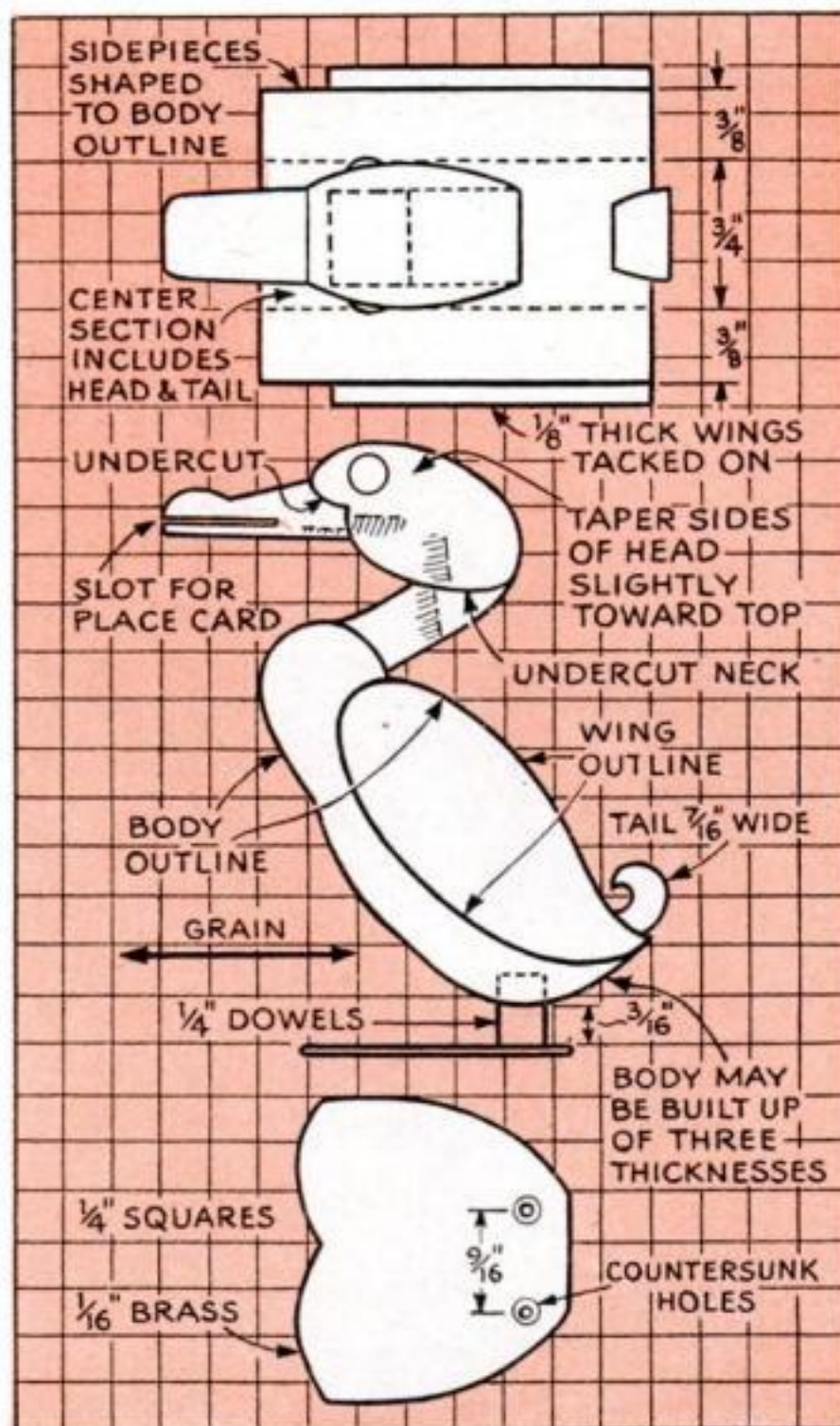
The creation of Juan Oliver, this quaint little bird is easier to make than it may first appear to be

BOTH children and adults will enjoy having these amusing little place-card holders on the party table. For that reason it may be well to make up two sets of them—one painted in bright colors for young guests, and the other finished as described below, for use at informal dinners.

The original was band-sawed out of $1\frac{1}{2}$ " mahogany, the shoulders and tail sawed and carved to shape, and part of the body left the natural color of the wood. However, any well-seasoned stock that does not split readily can be used. Carving can be simplified by gluing the body up of three pieces. See that the grain of the center section runs lengthwise of the bill.

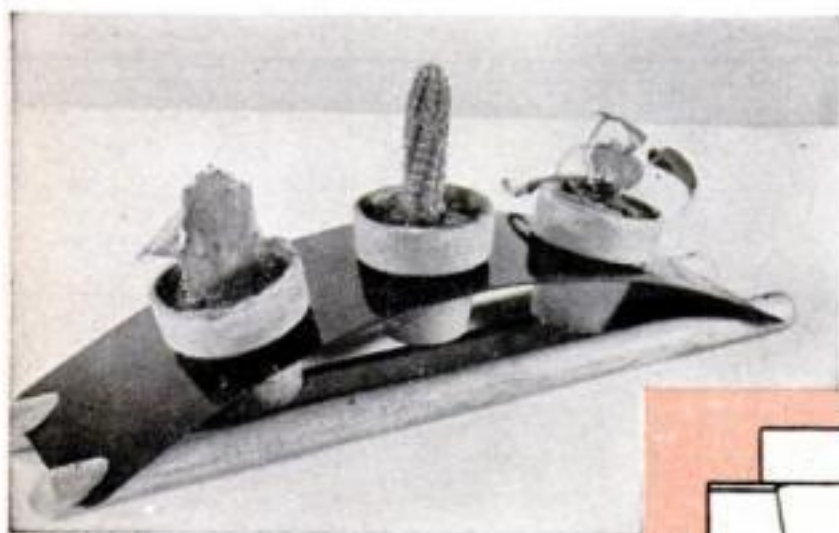
Drill the body for $\frac{1}{4}$ " dowels to serve as legs, and slot the bill with a fine saw blade. After sanding smooth, apply a thin coat of shellac, sand, and apply a heavier coat.

The top of the head, tail, and wings are black. The latter may be painted separately and bradded in place when dry. Paint the front of the neck and body white. Insert bright gilt upholstery tacks for eyes. Cut



the base out with a jeweler's saw. Attach it with $\frac{1}{2}$ " flathead brass screws to the dowels that form the legs.

Unique Dowel-and-Plastic Rack for Three Small Flowerpots



You can make this holder in an evening. Section at right shows how dowels are slotted for the bottom



SHAPE the ends of two 15" lengths of $\frac{3}{4}$ " dowel on a sander, and cut a $\frac{1}{4}$ " deep blind slot lengthwise in each one on a circular saw. The end slots are cut at an angle of 60 deg. Finish with two coats of clear lacquer. The curved top may be of phenol-formaldehyde plastic or plywood, $\frac{1}{16}$ " by $3\frac{1}{2}$ " by $14\frac{1}{4}$ ".

Cut the 2" holes for the pots with a circle cutter, on a jig saw, or by scoring with dividers. The 2" by $13\frac{1}{4}$ " bottom piece may be of the same material. Assemble with escutcheon pins driven into pre-drilled holes at each end of the stringers. Approximate time, 3 hours.—E. R. D.



Carved model of one of the most popular of the picturesque rifles used in the Civil War. Slightly over 19" in length, it presents an interesting problem in whittling. It can be mounted on a plaque, if desired

Historic Sharp's Rifle

IN A HALF-SIZE WHITE-PINE MODEL

BY CARL G. ERICH

THE prototype of this half-size whittled model is the Sharp's rifle, patented in 1852 and widely used in the Civil War. Experts consider it to have had the best of all breech-loading systems used in that period. Even the Confederates made Sharp's

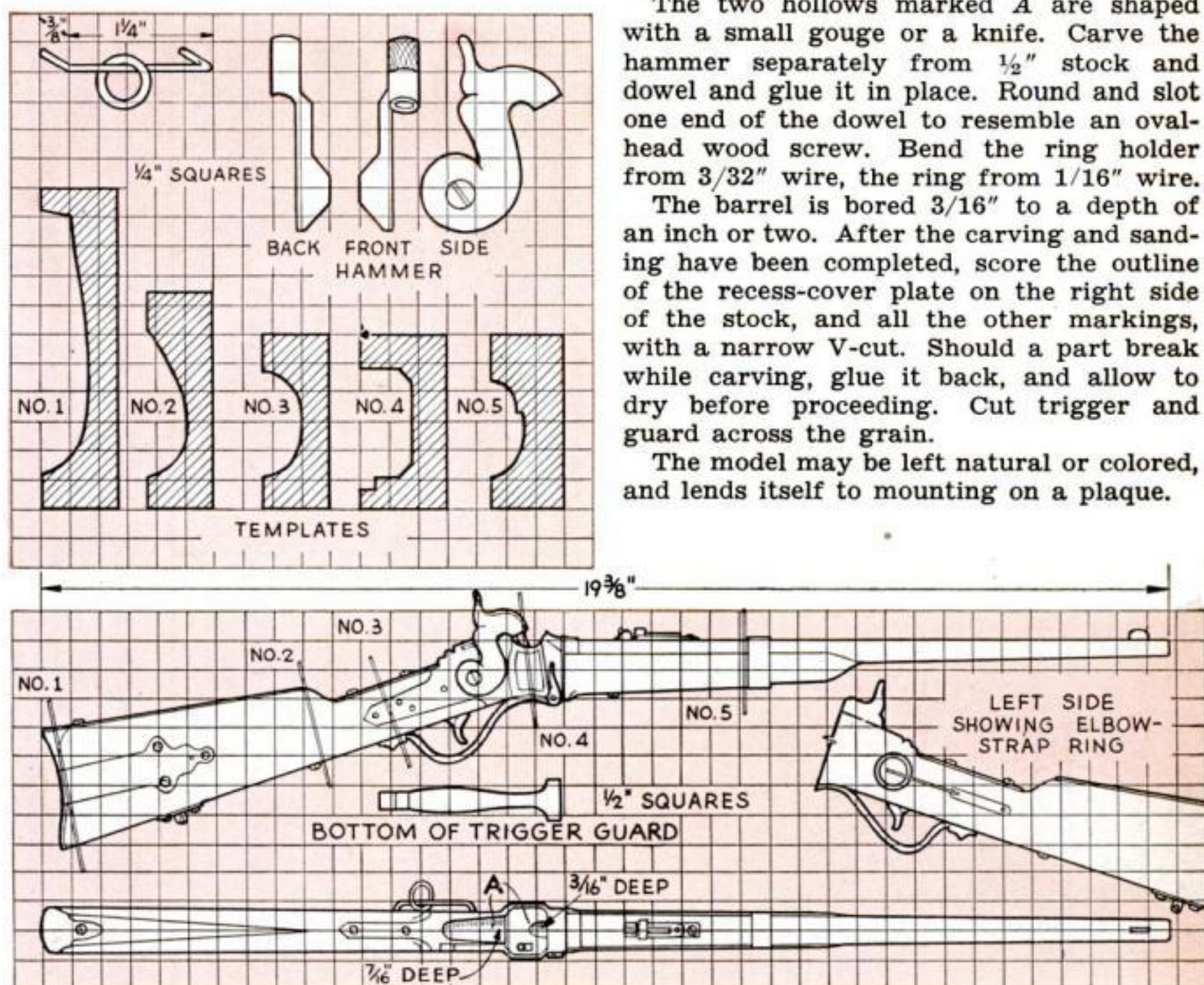
carbines in large quantities, although it was originally a Northern gun manufactured in Hartford, Conn.

Make a working drawing and transfer it to a 1" by 4" white-pine board. Jig-saw the inside of the trigger guard first, then the outside shape. Draw a center line around the sawed edge as an aid in carving.

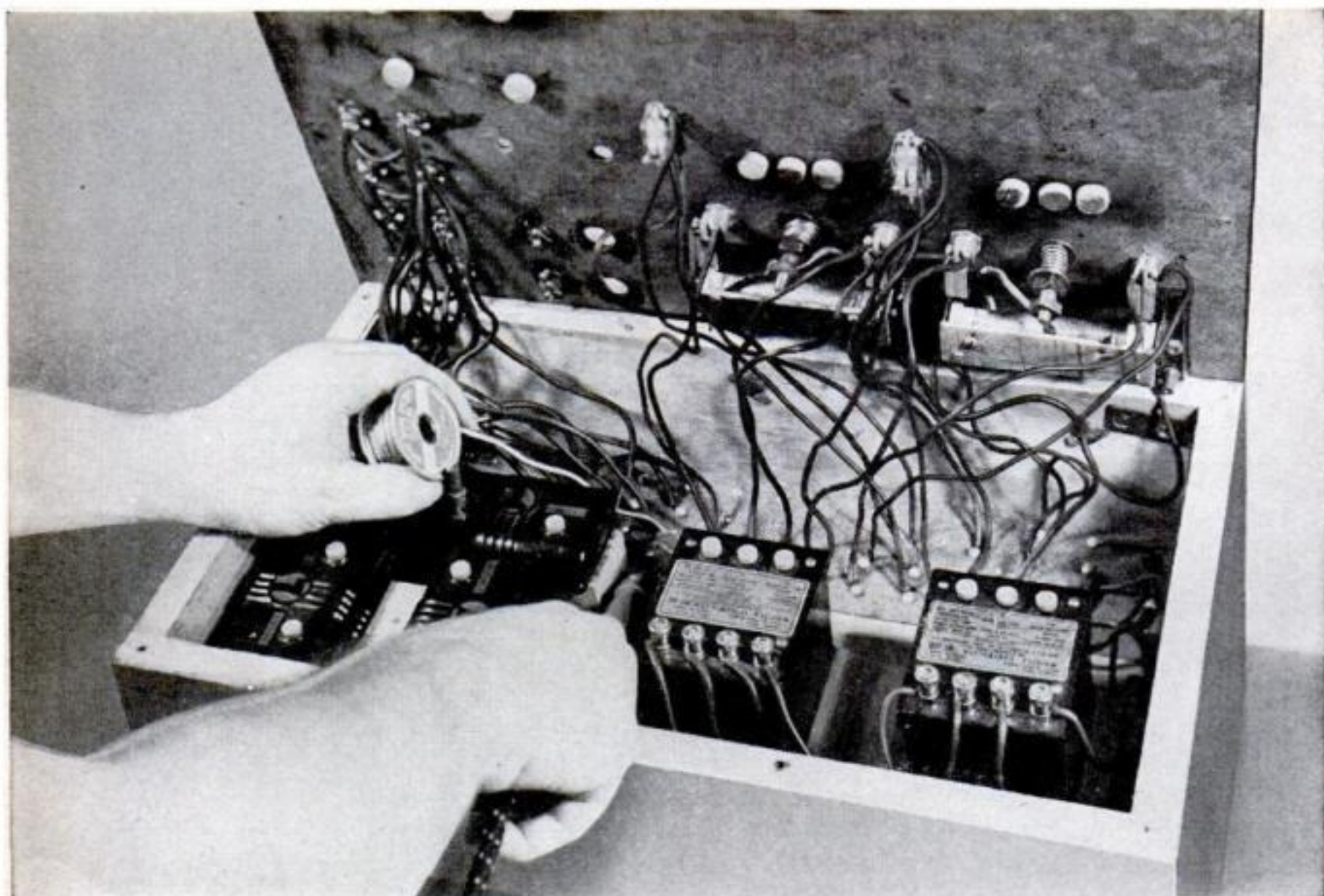
The two hollows marked A are shaped with a small gouge or a knife. Carve the hammer separately from $\frac{1}{2}$ " stock and dowel and glue it in place. Round and slot one end of the dowel to resemble an oval-head wood screw. Bend the ring holder from $\frac{3}{32}$ " wire, the ring from $\frac{1}{16}$ " wire.

The barrel is bored $3/16"$ to a depth of an inch or two. After the carving and sanding have been completed, score the outline of the recess-cover plate on the right side of the stock, and all the other markings, with a narrow V-cut. Should a part break while carving, glue it back, and allow to dry before proceeding. Cut trigger and guard across the grain.

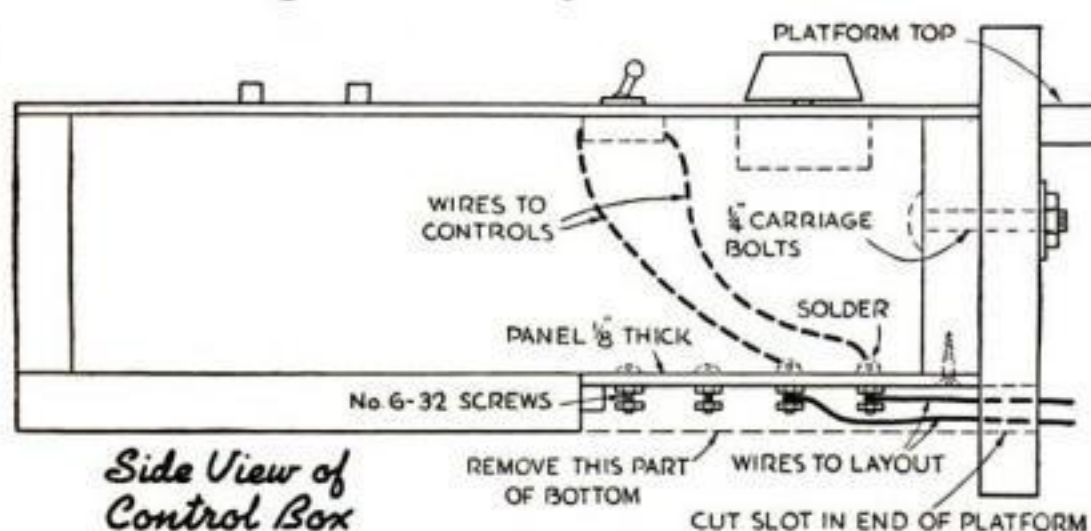
The model may be left natural or colored, and lends itself to mounting on a plaque.



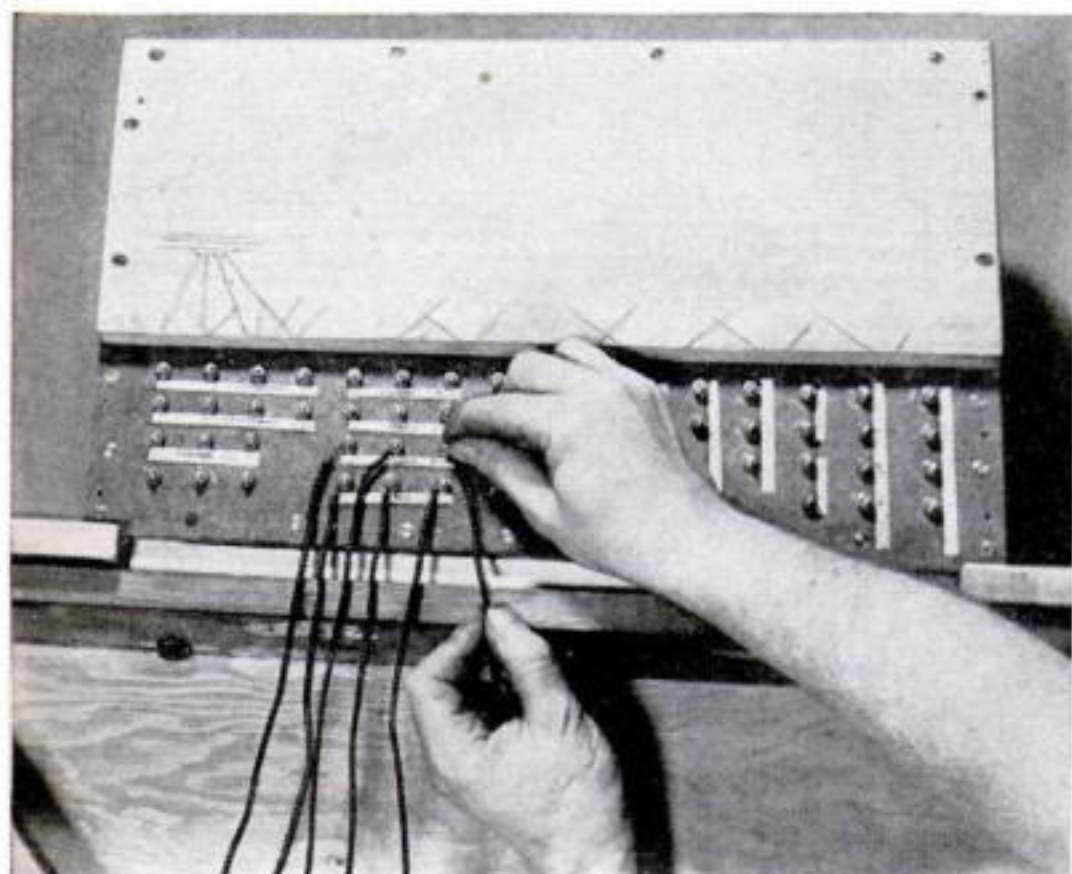
Working drawings of rifle, hammer, and templates. The rifle is laid out on $\frac{1}{2}$ " squares, while $\frac{1}{4}$ " squares are used to show the profile of the hammer and the templates employed in shaping the gunstock



Binding Posts Improve the Control Box of a Model Railway



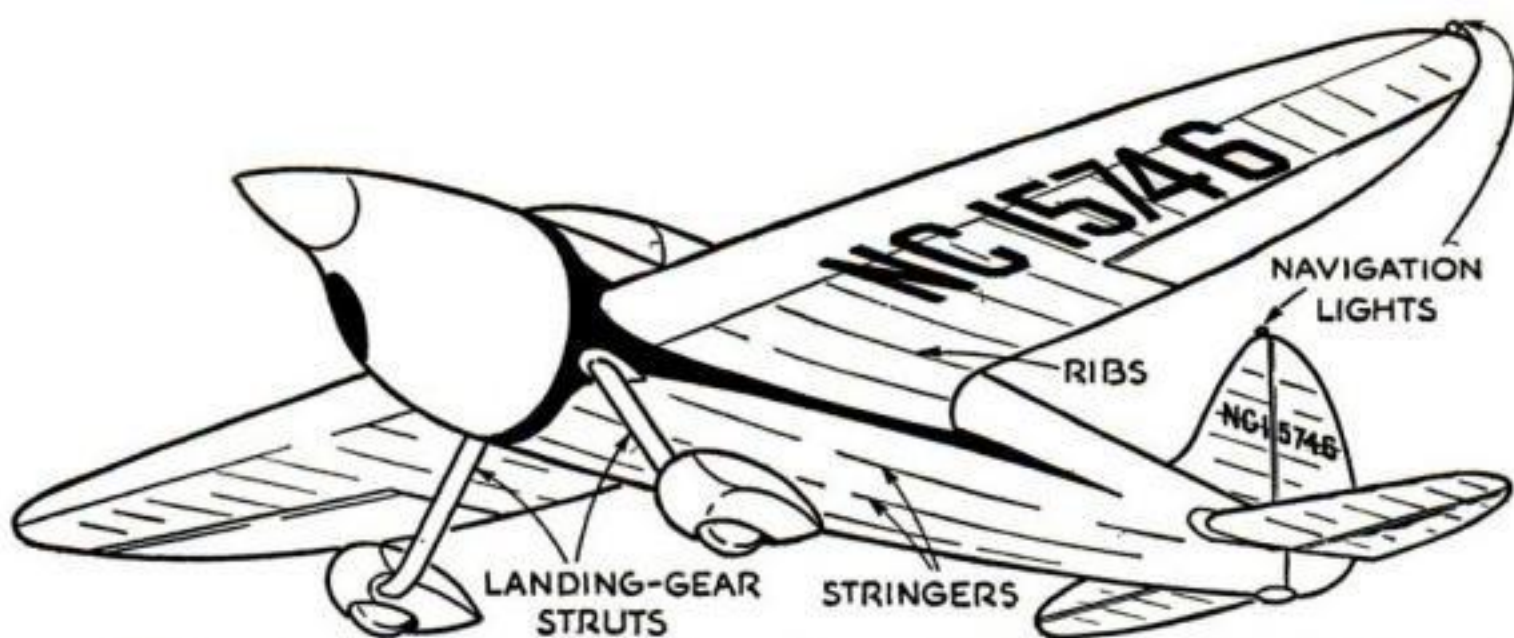
Side View of Control Box



MUCH time may be saved in wiring a complicated model-railway layout if the wires from the rheostats, switches, and other equipment housed in a control box of the type shown are brought out to easily accessible binding posts fixed to the underside of the box. The chance of making wrong connections is lessened.

Remove a section of the bottom of the control box and attach in its place a $\frac{1}{8}$ " panel of tempered composition wood or hard board. In this panel locate and drill holes on 1" centers to take No. 6-32 roundhead brass screws $\frac{1}{2}$ " long. Fasten these screws to the panel with lock nuts, and add another nut on each screw for securing wires to the layout.

Inside the box, solder connecting wires from the controls to the slotted heads of the screws, and identify the binding posts on strips of paper pasted adjacent to each group of posts on the outside of the panel. Nail blocks on each end of a $\frac{1}{4}$ " plywood cover to bring it flush with the bottom of the box. The side of the cover is left open for wires leading to the layout.—C. ELMER BLACK.



Better Detail on Scale-Model Planes

By FRANK ZAIC

REALISTIC nonflying scale models are easily made by carving the parts from the solid balsa and simulating the constructional features. Finish the surfaces smoothly before cementing the parts together. After assembling, apply several coats of dope and rub down with very fine silicon-carbide paper, used wet. Pores can be filled with successive coats of wood filler, each sanded well before the next is applied, or concealed by covering the model with thin silk or tissue paper before applying colored dope.

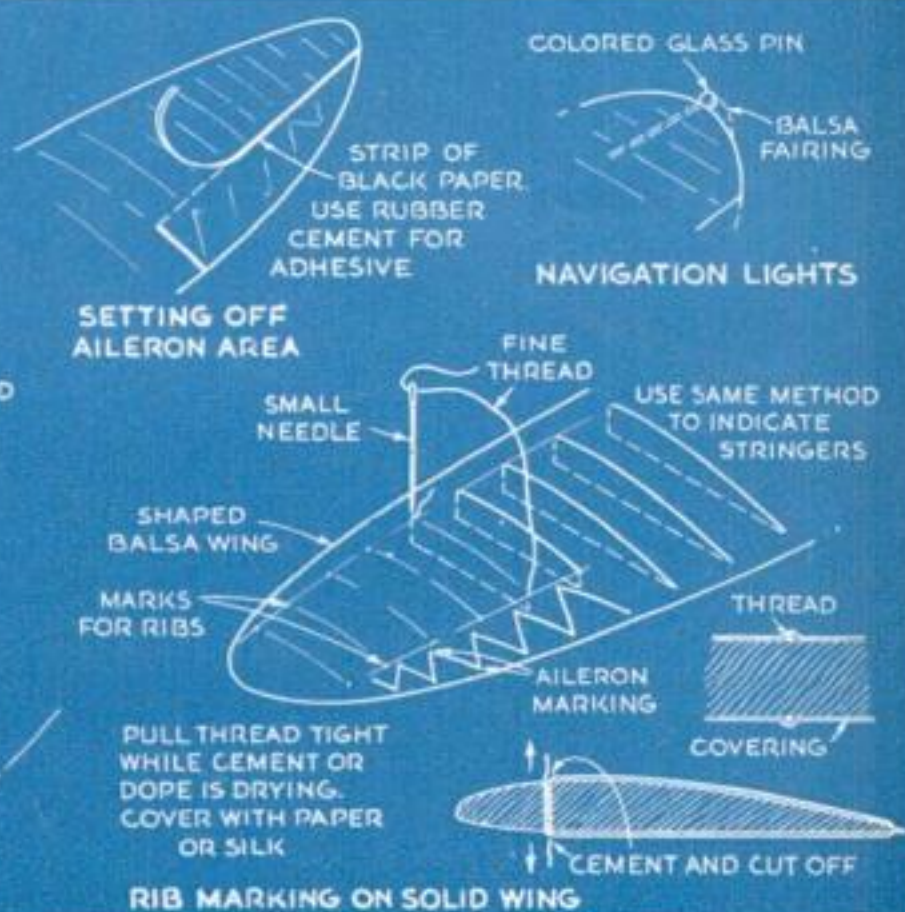
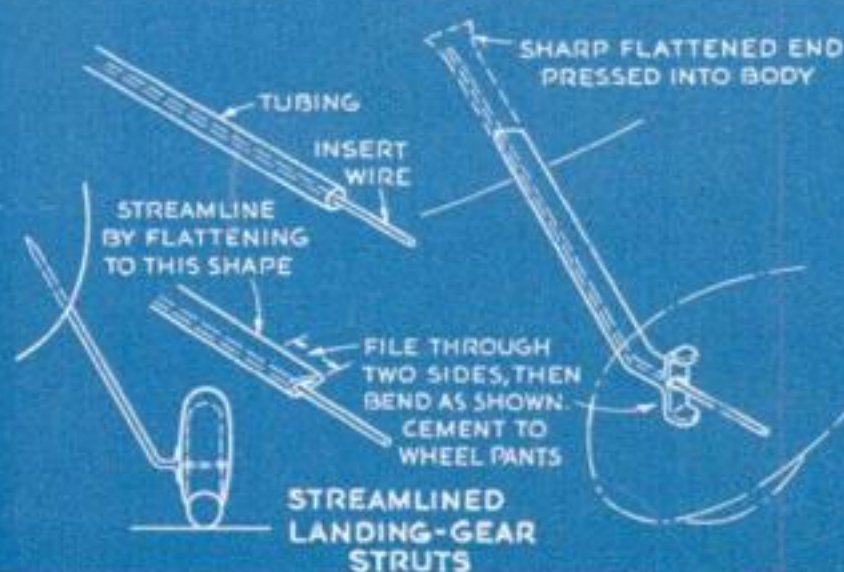
IMITATION RIB LINES. To give the appearance of ribs or stringers under fabric, stitch fine silk thread over the wing or fuselage as shown, pull tight, and apply dope sparingly along the thread. When dry, cut the waste ends off carefully. Be sure spacing is uniform. Cover entire wing surface and threads with paper or silk.

NAVIGATION LIGHTS. Put colored-glass push pins into the edges of the wings and rudder; then cement on fairing pieces of balsa shaped in front to fit the pinhead.

MARKING OFF SURFACE AREAS. Apply very narrow strips of black paper, using rubber cement as an adhesive, to set off rudder and aileron areas. This method may also be used for forming stripes on long or flat surfaces. Spread rubber cement on both the surface and the paper strip, let dry, and press the strip in place.

STREAMLINED LANDING-GEAR STRUTS. Wooden struts are easily broken, and it is hard to fasten wire axles to them without resorting to unsightly thread bindings. The strut shown is made of thin-walled tubing and wire. Insert the latter before squeezing the tube to shape. Press and cement the flattened upper end of the tube into the fuselage. The bottom end may be bent out as shown to provide a cementing area for wheel "pants."

Aileron and rudder areas may be marked with strips of paper, and navigation lights represented by colored pins, as at right. Below, construction of landing-gear struts. At right below, a way to imitate rib lines



Storing Your Boat for the Winter

NEGLECT and improper storage during the winter probably damage more boats than are ever worn out from normal use. Time spent in caring for your craft in the late fall will be more than repaid when you take to the water again, and may prevent serious and costly checking, opening of seams, and other troubles.

SMALL BOATS. Store in an unheated garage, shed, or boathouse, comparatively dry and with good circulation of air. Kayaks or canoes can be laid on an overhead rack; short outboard boats stood on end. A boat that cannot be stored indoors may be kept under a building if there is room to raise it off the ground, out of reach of snow and rain. Excessive drying of planks results from storage in a heated room or near a furnace. Paint may crack, seams open, and planks check or even split. Dampness causes fittings to corrode, and often buckles planks, especially on the deck or sides. Bad air causes dry-rot.

CRADLE FOR LARGER BOATS. Craft bigger than a rowboat or small outboard runabout must

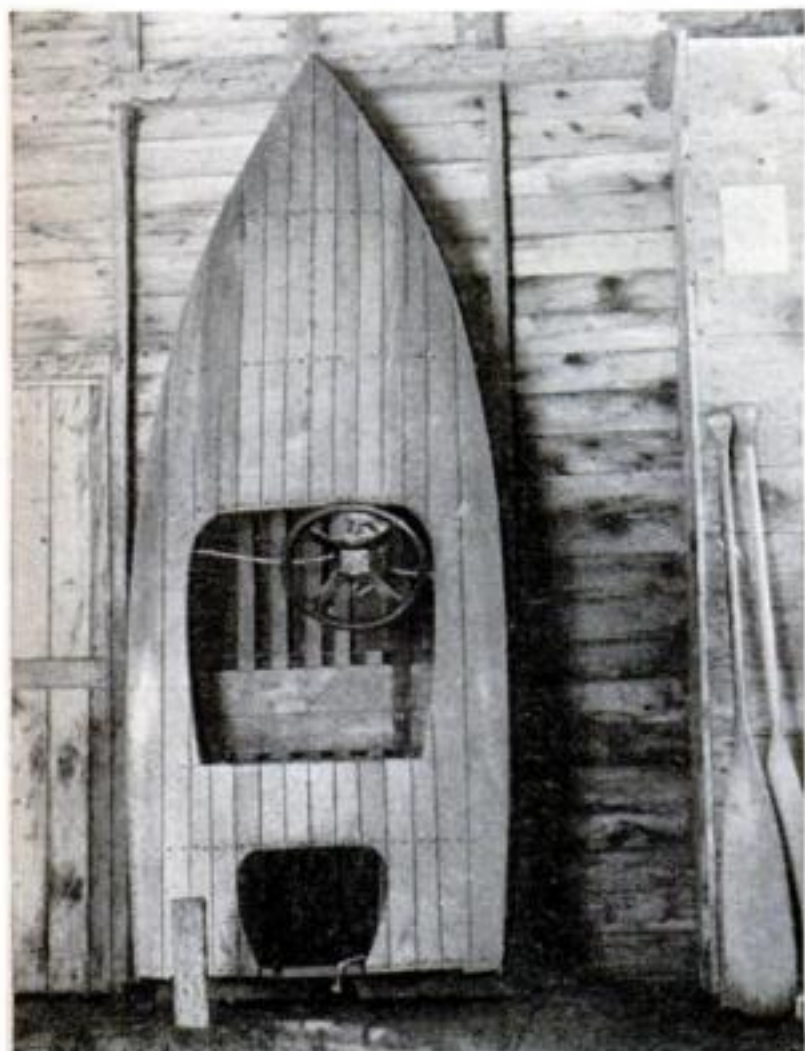
be supported to prevent sagging. A cradle to fit the bottom is ideal. It should have three or more cross-bearers, depending upon the size. The boat may be floated over a cradle, under which rollers have been placed, and pulled up on shore with an automobile. An auto trailer with a cradle on it to fit your boat is excellent for storage.

Craft so large that they must be hauled out on marine ways and stored in a regular boat yard should be blocked up as shown in the drawings, the keel supported at no less than three places.

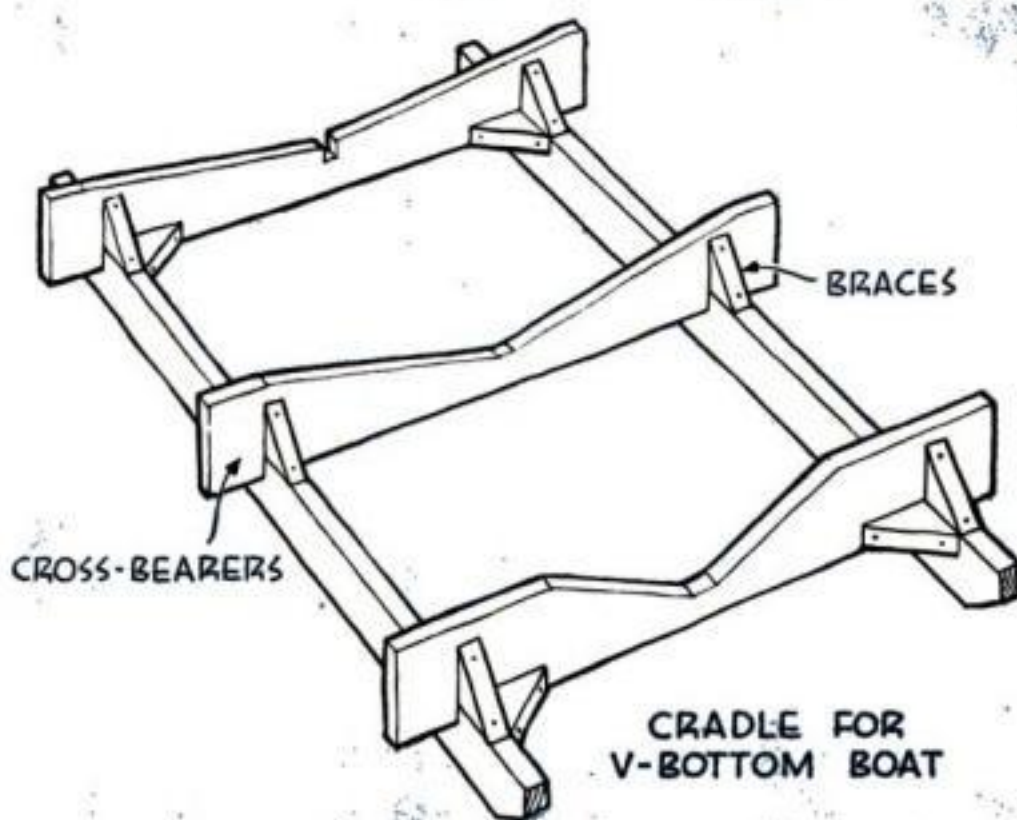
CANVAS COVER. For outdoor storage, a cover is necessary. Canvas is satisfactory if supported on a framework to shed rain and snow. The framework should have a ridge-pole, rafters, and eaves battens. The battens hold the canvas away from the hull, permitting air to circulate inside. The canvas may be nailed or lashed down. It should be at least 10-oz. material, preferably waterproofed. Tar paper may be used, but will last only a single season.

WATERPROOF-PLYWOOD COVER. Outdoor plywood will outlast canvas. Make the cover in sections, numbered for reassembling the next fall. Still better is a collapsible shed of waterproof plywood.

OUTBOARD MOTORS. Drain the cooling system. Remove all water from the gear housing, and pack with fresh grease. Remove the



To save space, as in a garage, small boats can be up-ended and stored against a wall. Drawings at right and on facing page show a cradle, a cover framework, and blocking



BY
**BRUCE AND WILLARD
CRANDALL**

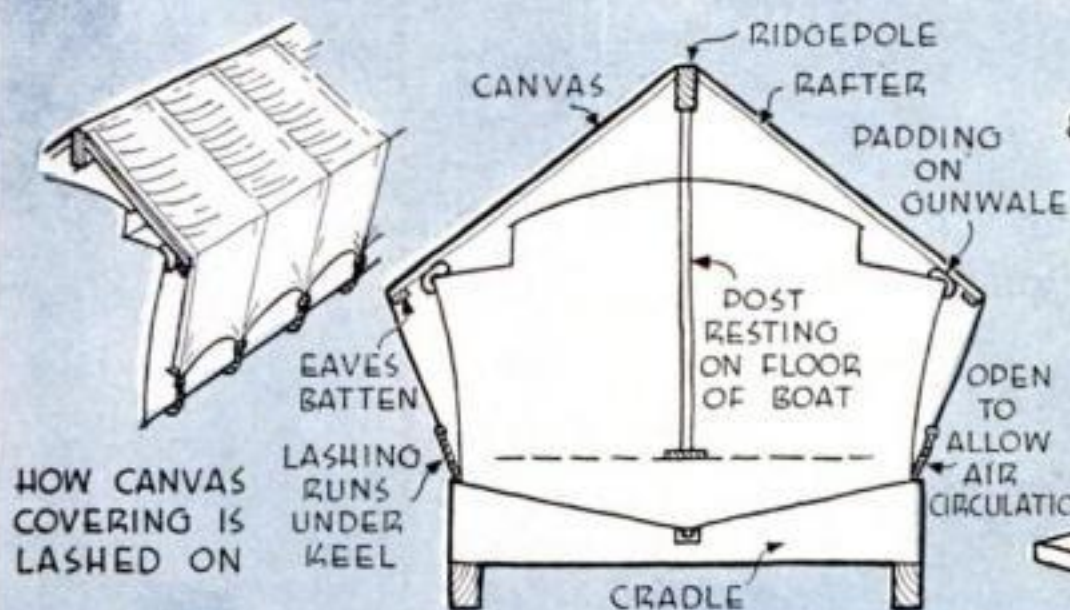
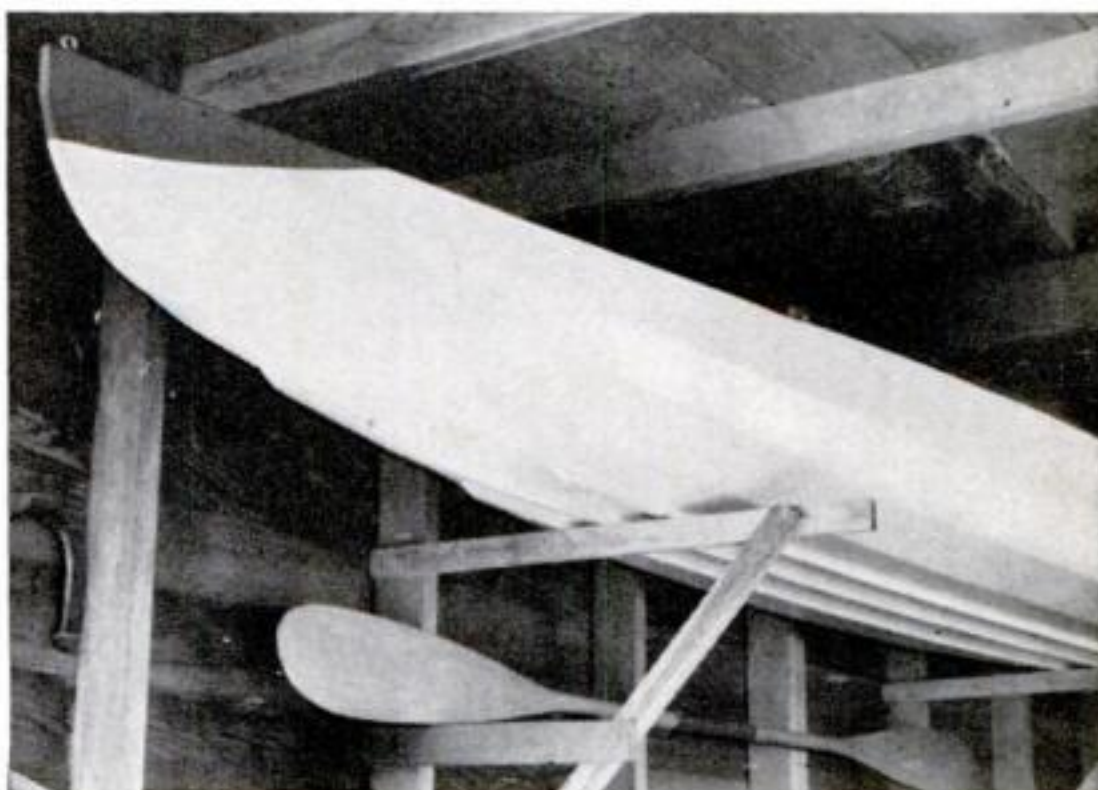
spark plugs and pour a teaspoonful of lubricating oil into each cylinder. Turn the flywheel over several times, and replace the plugs. Wipe the outside with a cloth soaked in oil, and wrap to protect the ignition system from dust. Store the motor in a dry place.

INBOARD-POWERED BOATS. Drain the water from the bilge, and be sure fresh air can circulate to all parts inside the hull. Drain all water from the motor, water pumps, bilge pumps, and water tanks. Put a teaspoonful of oil into each cylinder and turn the motor over a few times. Drain the gasoline tanks, and loosen the turnbuckles in the steering line. Coat with grease any parts likely to rust. To prevent the battery from freezing or deteriorating, remove it and keep it charged during the winter. It may be advisable also to remove certain ignition parts and store them in a dry place.

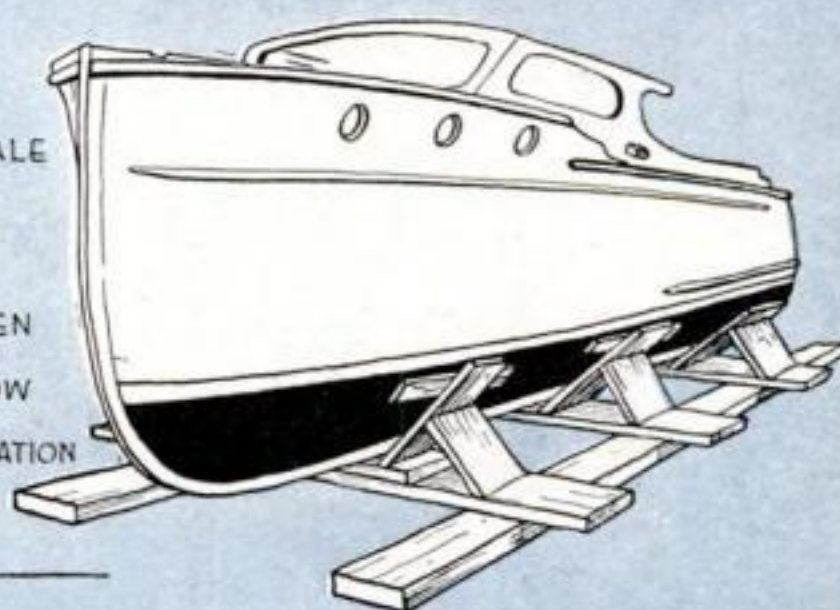
SAILS. To prevent mildew, store sails in a dry, well-ventilated place, hanging them and rope gear out of the reach of rats and mice.



Boats under 20' in length can be hauled out of the water on rollers, as above. Float the hull over the cradle, put rollers underneath, and pull with your automobile. Below, kayak is on overhead rack for winter storage. Handle canoes the same way



CROSS SECTION OF FRAMEWORK FOR CANVAS COVER



ROUND-BOTTOM CRUISER
BLOCKED UP FOR WINTER STORAGE

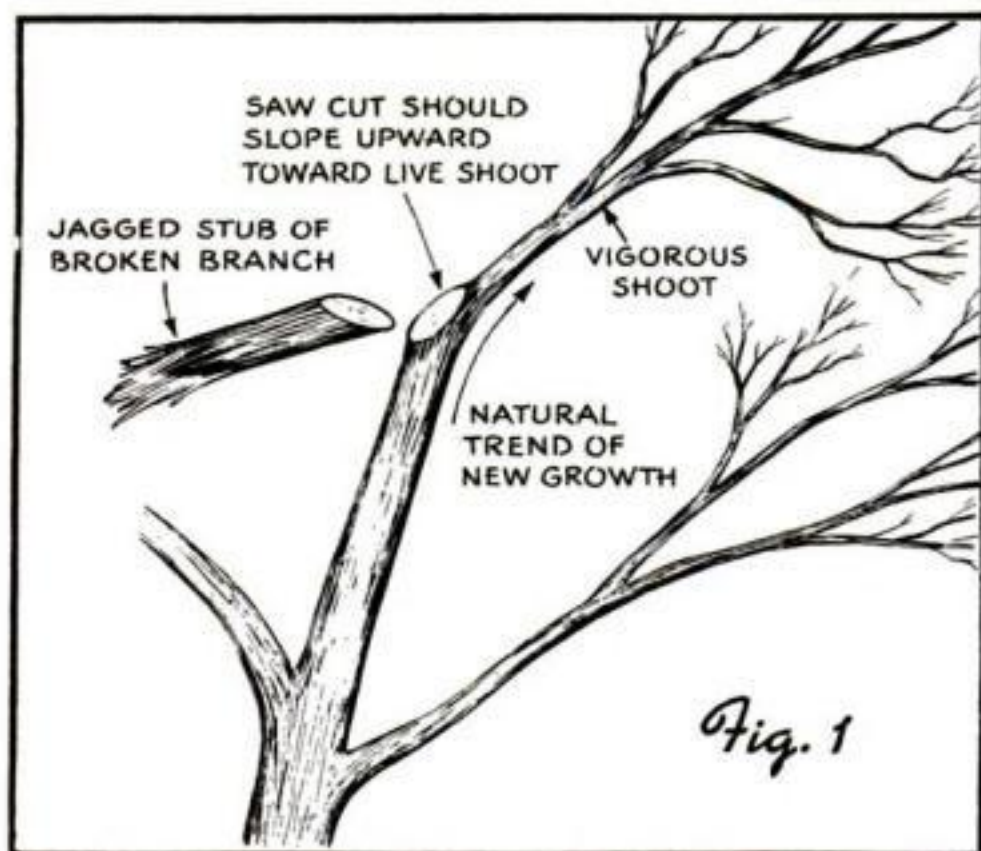
HOW TO SAVE Storm-Damaged Trees

By JOHN MODROCH

MANY a splendid tree lost because of storm damage cannot be replaced at any price. Prompt attention given such a tree may save it or at least forestall the need for expensive tree surgery later on.

The jagged stubs of broken limbs and branches should be removed as soon as possible (Fig. 1). If a heavy limb is broken near the trunk, saw it off as close to the trunk as possible, leaving no projecting stub. To prevent the limb from falling and stripping off the bark, support it with a prop or a rope (Fig. 2). Where this is impracticable, make two preliminary cuts in the order shown in Fig. 3. A branch left without a vigorous shoot at its tip will usually die.

A narrow-bladed, coarse-toothed pruning saw is the most practical one, but a keyhole saw is useful for working in crotches on small branches, and a coarse-toothed rip saw can



CUT BROKEN BRANCHES on a slant back to the nearest vigorous shoot. If none is nearby, trim off the splintered end and watch for signs of new growth, whereupon the break may be cut back toward it

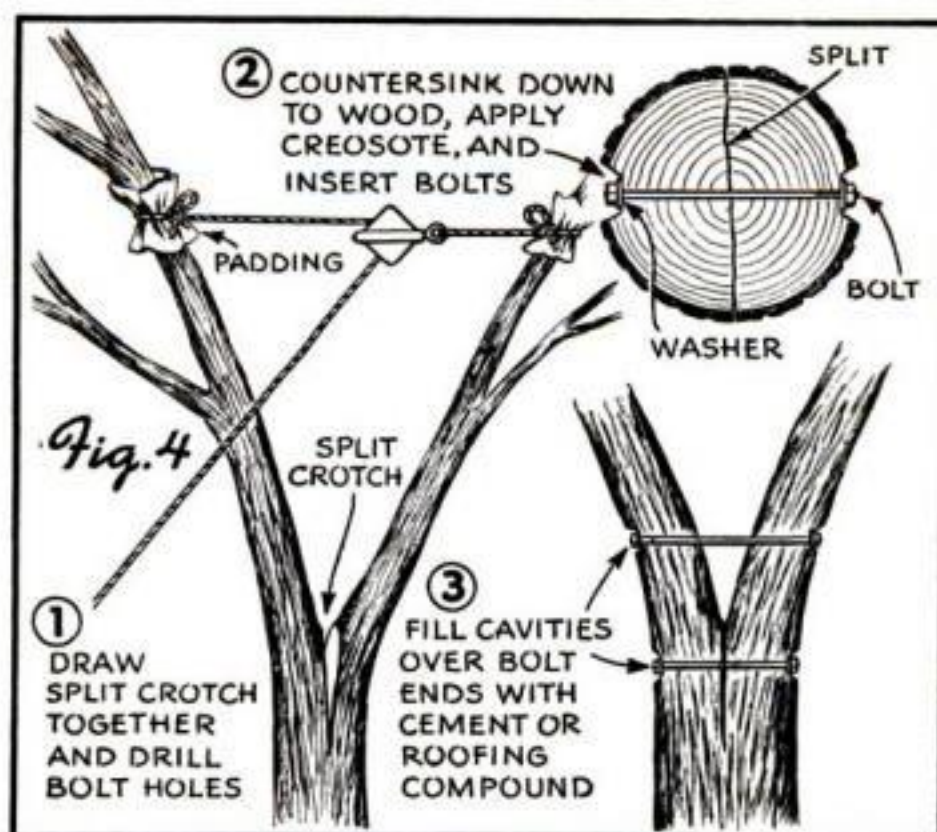


be used on heavy limbs. A bolt cutter, if available, can be used for pruning small branches and twigs.

The fresh wounds of most trees should be protected. Common shellac, creosote, white lead, and asphaltum paint are all satisfactory for this purpose. Because of their antiseptic qualities, either creosote or shellac is often used as a first coat, followed by a more durable second coat of asphaltum paint, or a brushing mixture of white lead and linseed oil, to which lampblack may be added to match the gray of the bark. Outdoor spar varnish also may be used as a second coat.

However, no dressing should be used on the wounds of stone-fruit trees such as peach, plum, and cherry. Furthermore, the gummy sap that exudes from the wounds of resinous trees, such as pines, amply protects them, and it is necessary only to smear the resin well over the cut surface. Care should be taken not to cover uninjured bark with paint or any other substance that would seal its pores. During sap-flowing seasons, some trees are difficult to dress. Apply the dressing immediately upon completing the cut, before the rush of sap has begun.

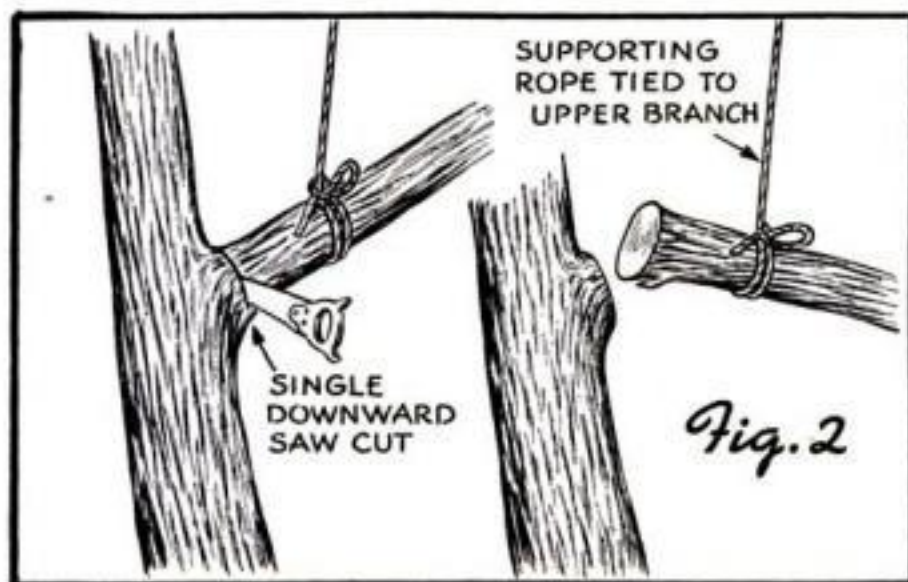
Long iron bolts (Fig. 4) can be used to prevent a weakened crotch from splitting and to draw the parts of a split crotch to-



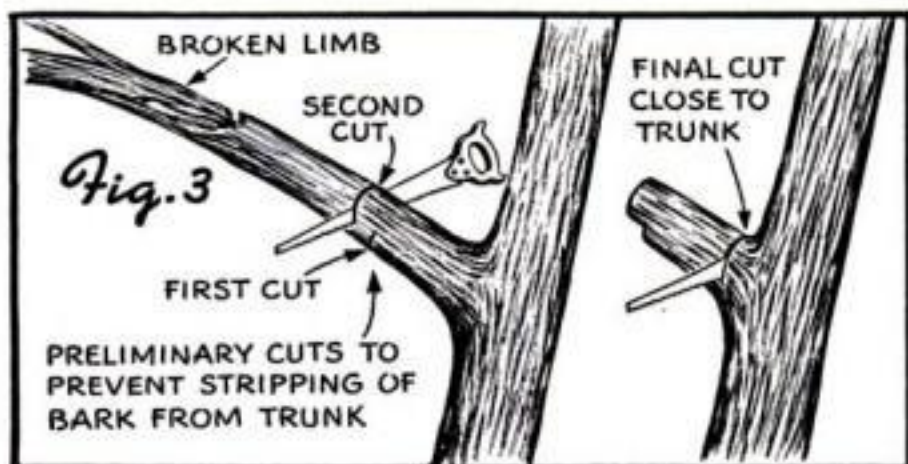
HOW TO REINFORCE a tree that has cracked in a crotch. If the crack is wide, use a rope tackle to draw the parts together before drilling the bolt holes

gether. Creosote the holes as thoroughly as possible, as well as the countersunk areas, before putting the bolts in place. Finally, cover the bolt ends with Portland cement or asphaltum roofing compound.

Burns, whether caused by lightning or fire, are self-sterilizing. Scrape off the charred wood and apply one of the second coats previously mentioned.

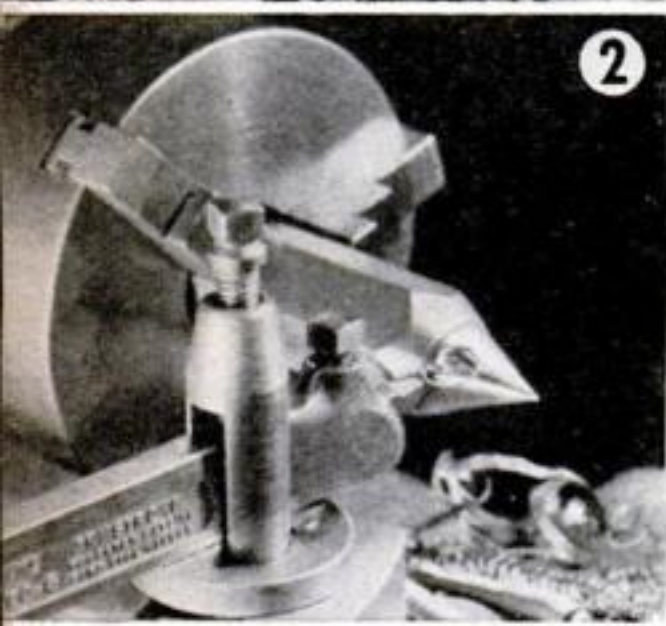
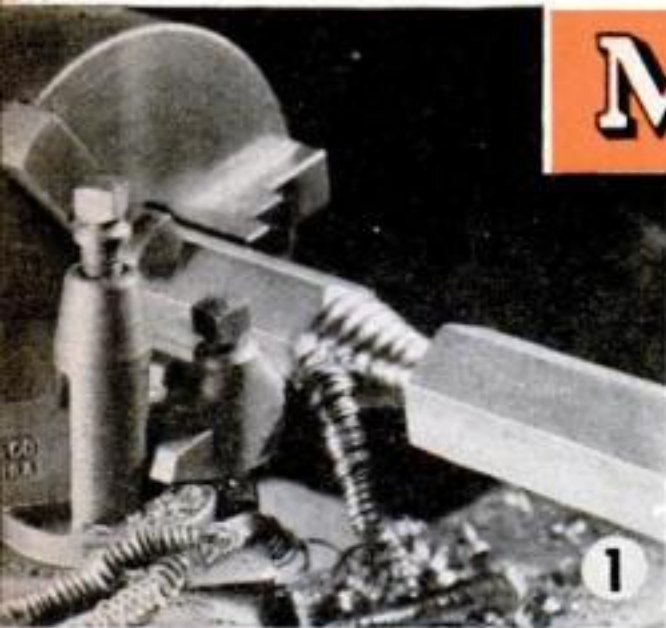


IN CUTTING OFF HEAVY LIMBS, support them with a rope or prop and saw as close to the trunk as possible. Where this is impracticable, make cuts in the order indicated below



EXCEPT ON STONE-FRUIT TREES and very resinous trees, all cuts and wounds should be dressed. In sap-flowing seasons, apply the dressing to each saw cut at once, before the sap has a chance to ooze out

MACHINISTS FOR



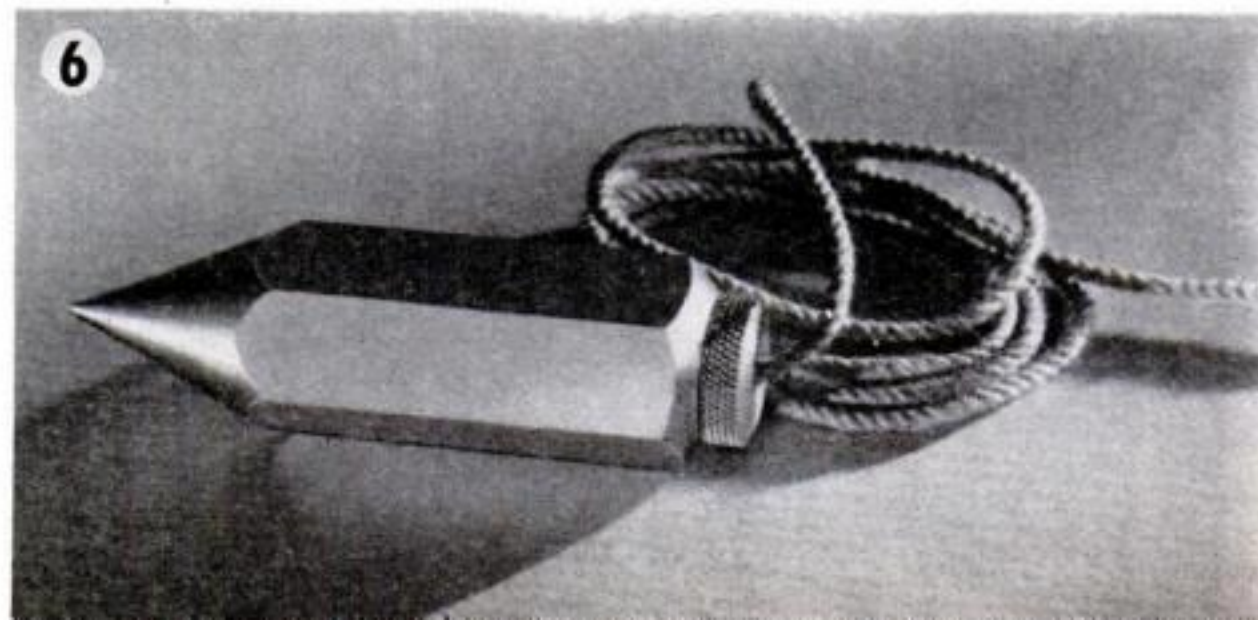
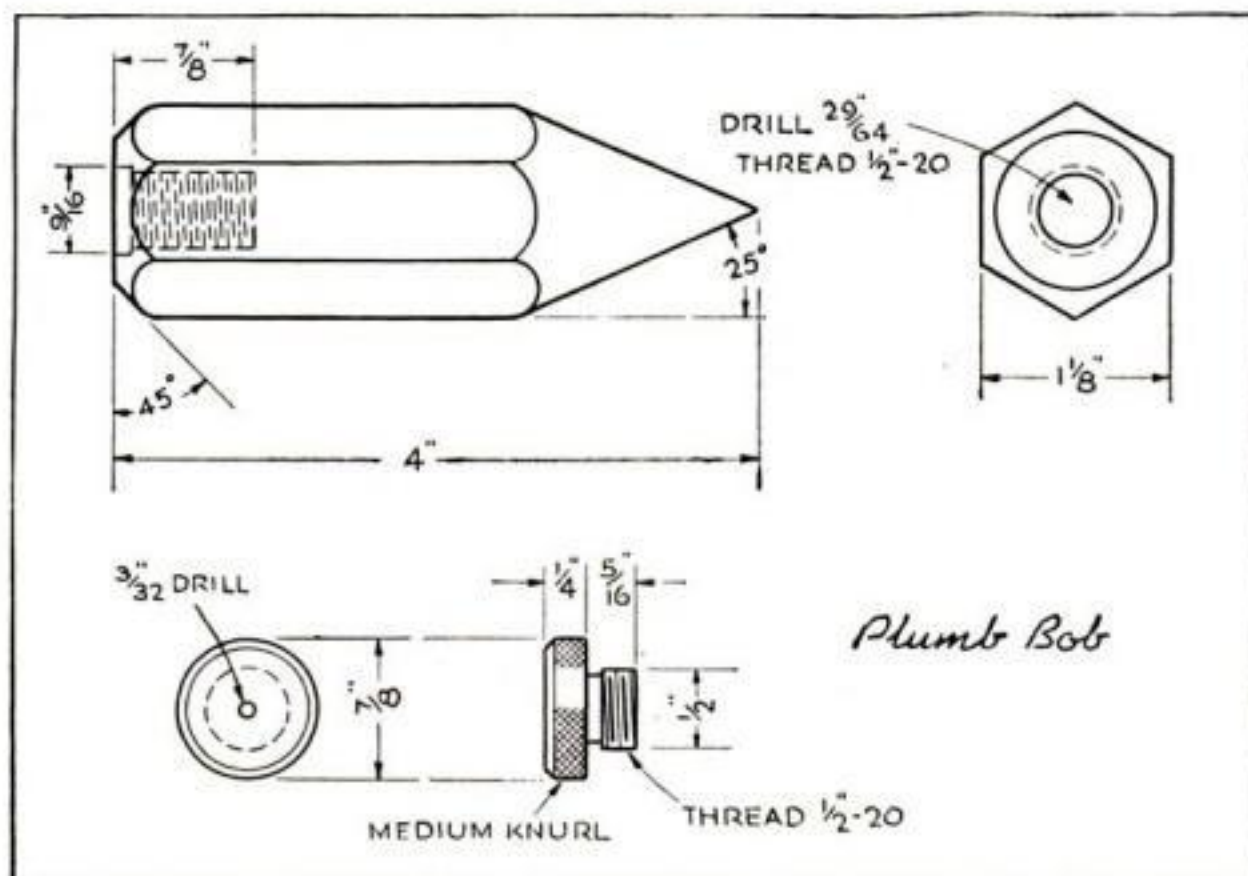
TO COMPLETE the industrial mobilization of America, a huge army of new machinists is needed. Some of these men are being trained in vocational, industrial, and technical schools; others have to acquire a knowledge of machine-shop practice while hard at work in factories and shops. In an effort to help both classes, POPULAR SCIENCE has prepared a series of instructive, useful projects. The first four appear in this issue and others will follow.

Turning a Plumb Bob from Hexagon Stock

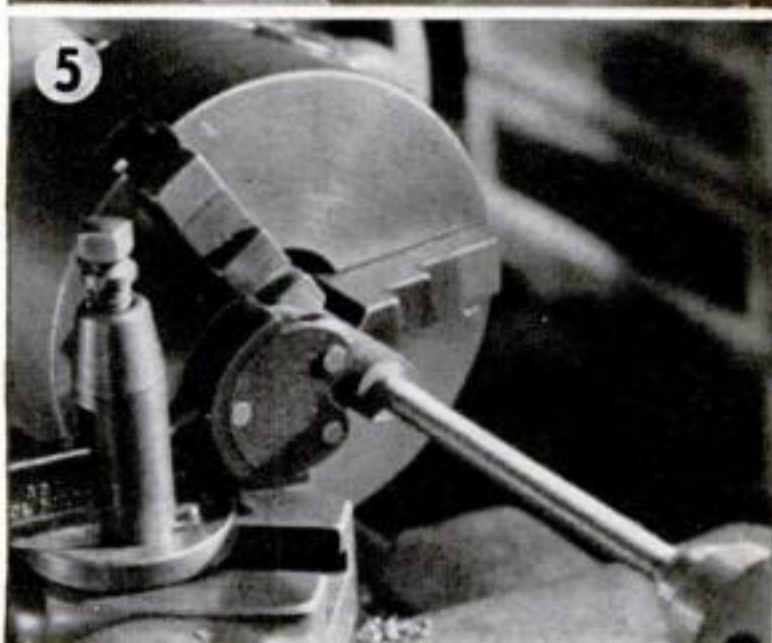
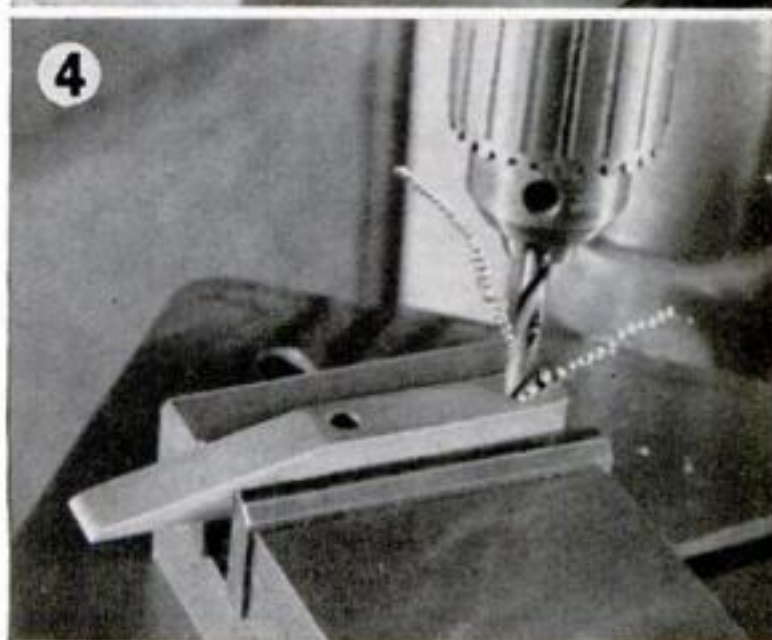
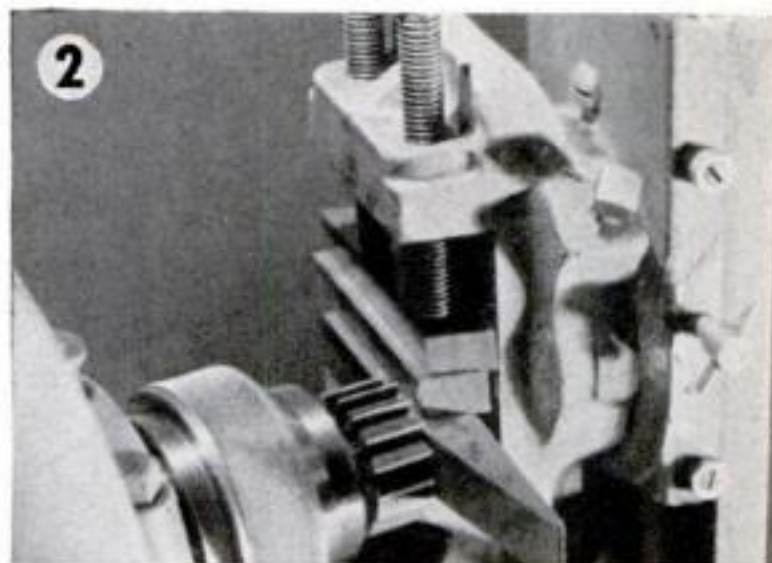
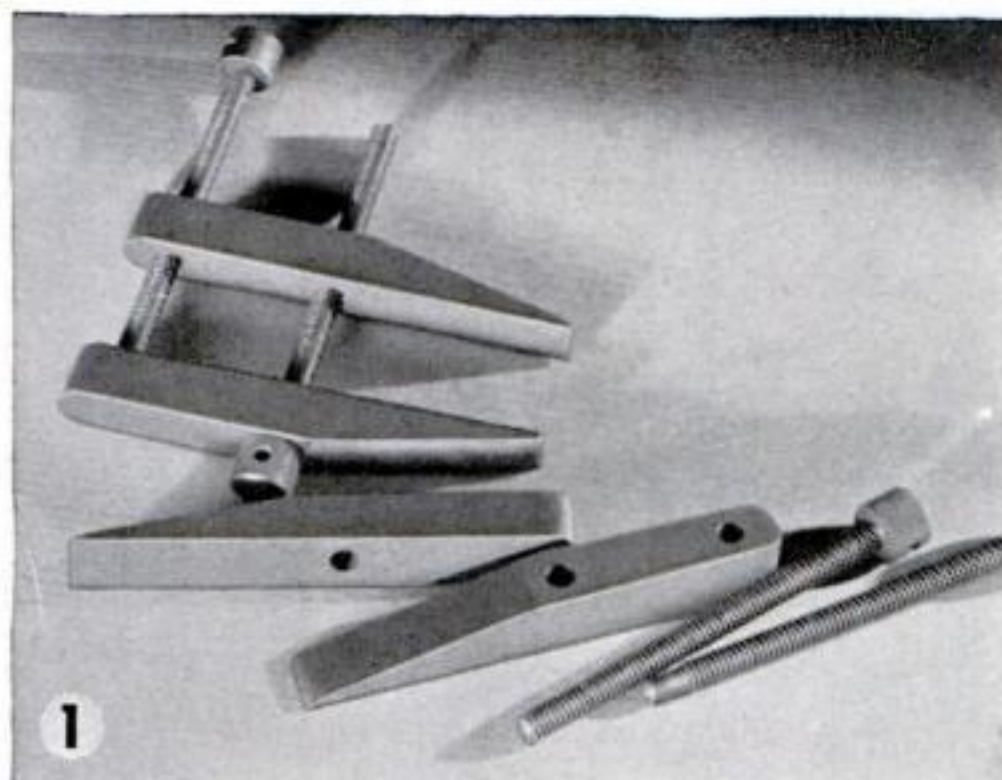
AN ACCURATE plumb bob can be made quickly from either brass or steel. A short piece of $1\frac{1}{8}$ " hexagon stock is chucked in the lathe and supported by the tailstock while the roughing cut is made, as shown in Fig. 1. After the point has been roughed out, the stock is cut in two, and a finishing cut taken (Fig. 2). The stock is then reversed in the chuck (Fig. 3), and the end drilled and tapped to the dimensions given in the drawings below. By supporting the outboard end of the tap with the tailstock center as shown also in Fig. 3, the threads can be accurately cut.

The small end cap is turned to shape on the end of a solid rod (Fig. 4), then threaded, drilled, knurled, and cut off. This cap (Fig. 5) allows the cord to be fastened centrally.

The completed plumb bob, with cap and cord attached and ready for use, is shown at the bottom of the page in Fig. 6.



By C. W. WOODSON



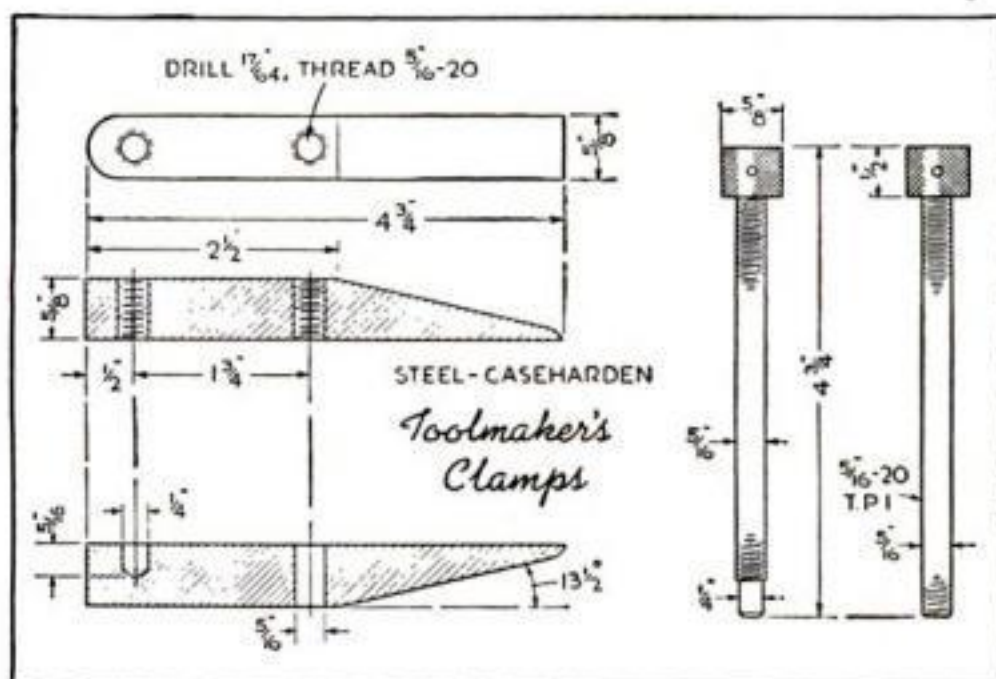
How to Make a Pair of Small Clamps

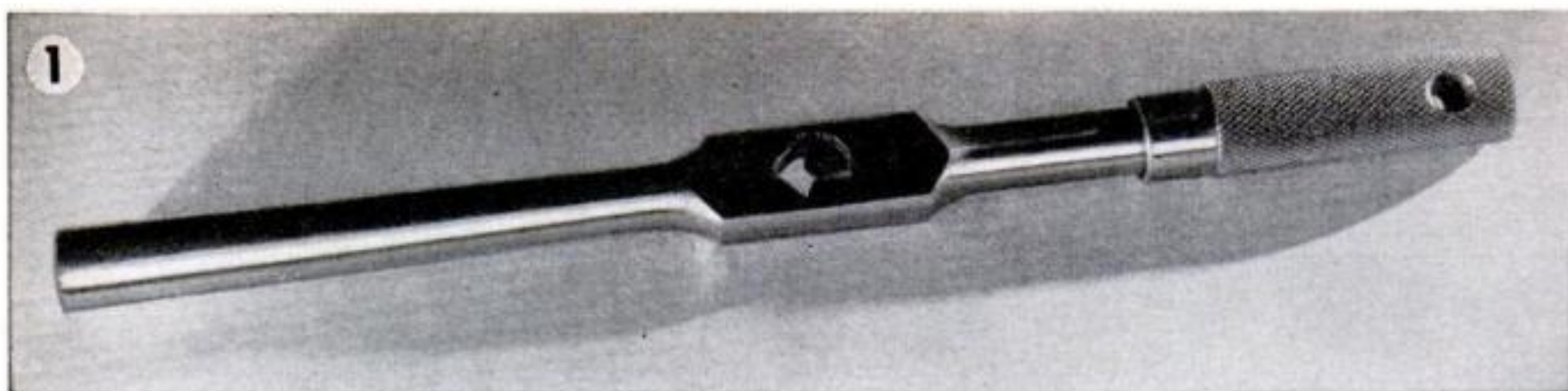
TOOLMAKERS' clamps have many uses. As a rule, they are purchased, but making a pair is an instructive project.

The clamp jaws (see Fig. 1 and drawings) are made from $\frac{5}{8}$ " square stock, while the screws are turned from $\frac{5}{8}$ " round stock. Both, when complete, are casehardened.

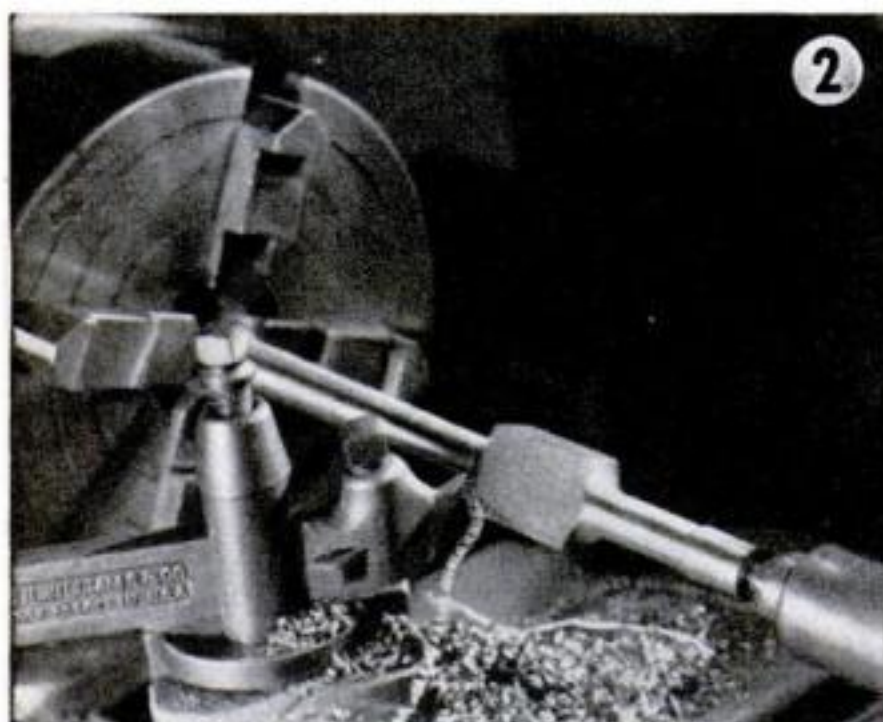
When the stock for the jaws has been cut to length, each jaw is milled at an angle in the milling attachment, which is set at $13\frac{1}{2}$ deg. (Fig. 2). The back end of each is then rounded on the disk sander (Fig. 3) and the holes for the screws are drilled (Fig. 4). One jaw is drilled with two $\frac{17}{64}$ " holes and tapped $\frac{5}{16}$ "-20, while the other jaw is drilled at one end to clear one screw, and drilled partially through at the other end to receive the shouldered screw.

The screws are turned, threaded, and knurled at one chucking (Fig. 5). A $\frac{5}{32}$ " hole is drilled through the head of each for a short steel rod.



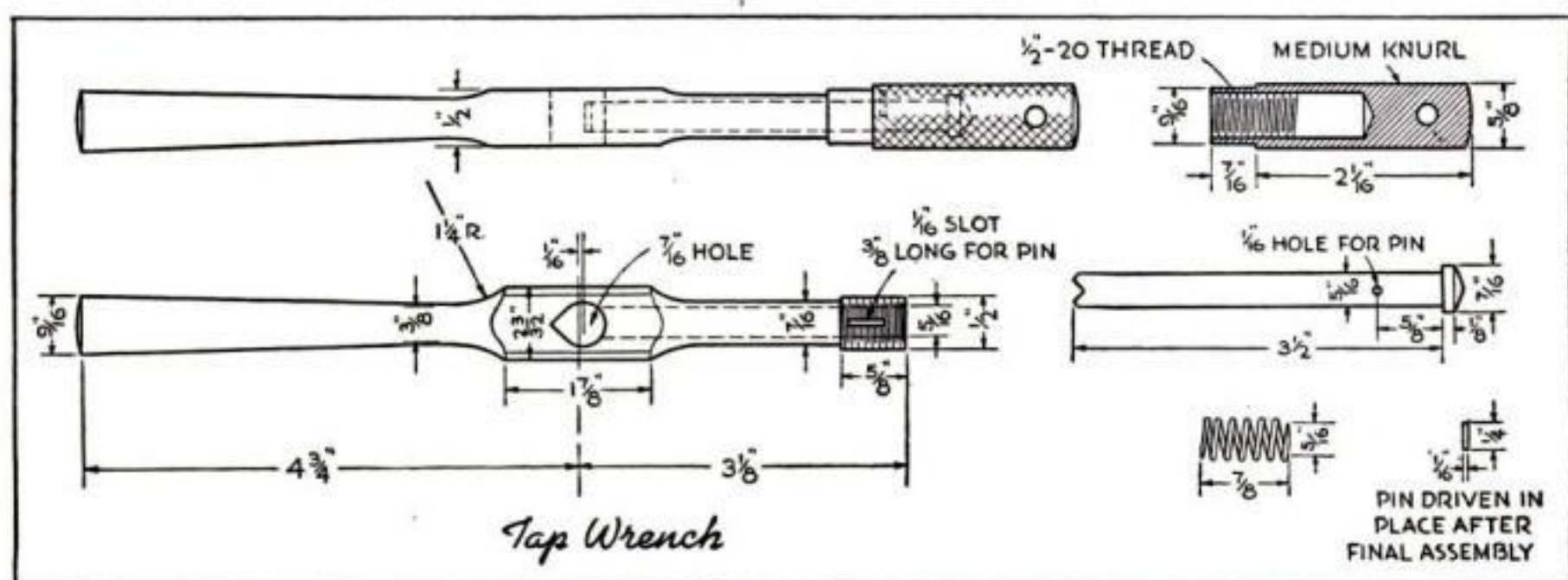
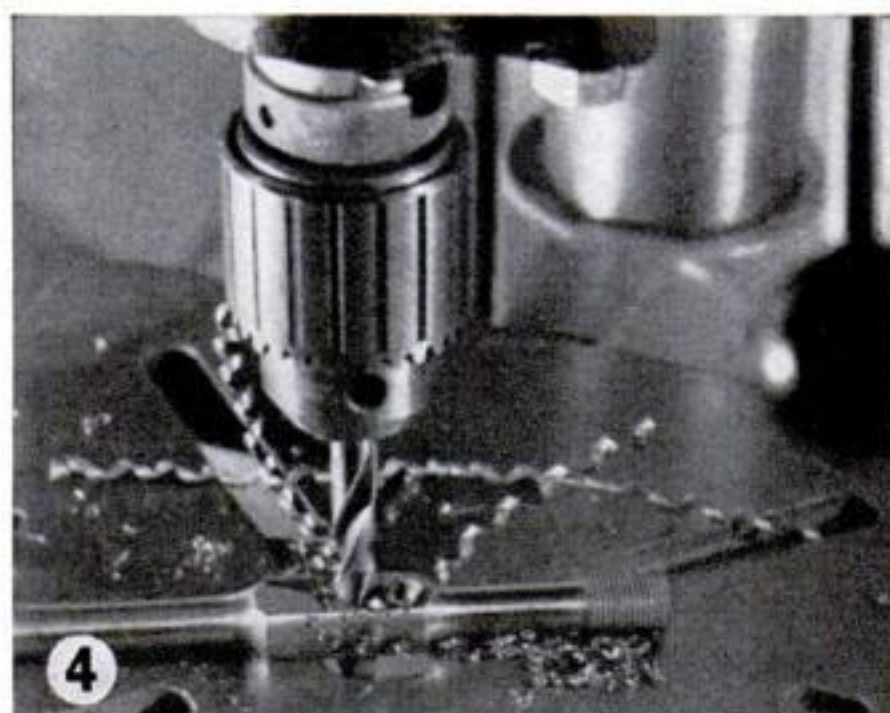


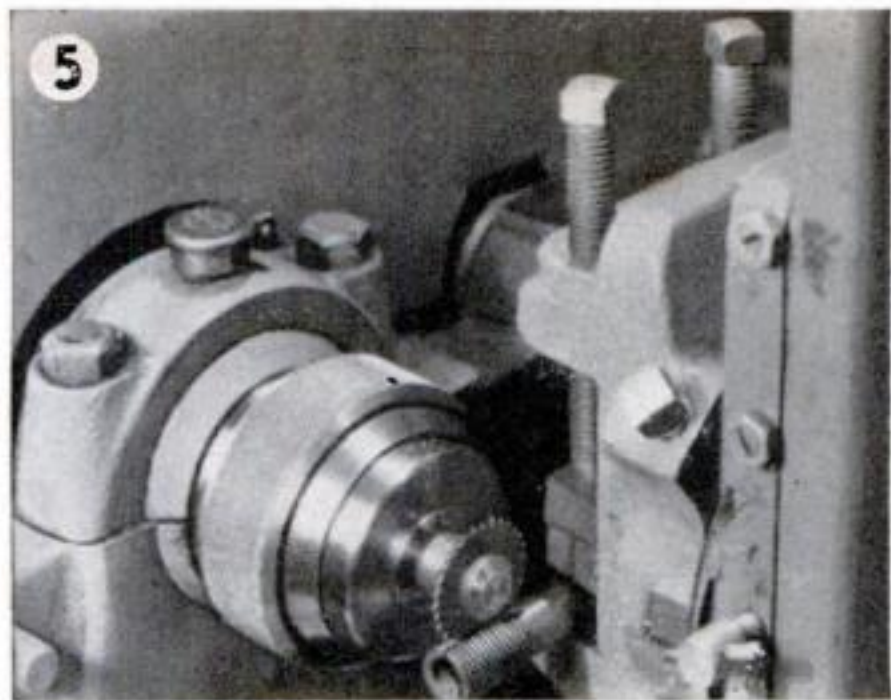
Constructing a Set of Tap Wrenches to Add to Your Tool Kit



THE tap wrench shown in Fig. 1 and the accompanying drawings will take taps from $\frac{3}{16}$ " to $\frac{5}{16}$ ", but the dimensions can be changed and the wrench made smaller or larger. A set of three of these tap wrenches in your kit would handle a wide range of taps, as well as reamers and drills with square or round shanks. Turning them in the lathe is not a difficult operation, but it will add materially to your practice work.

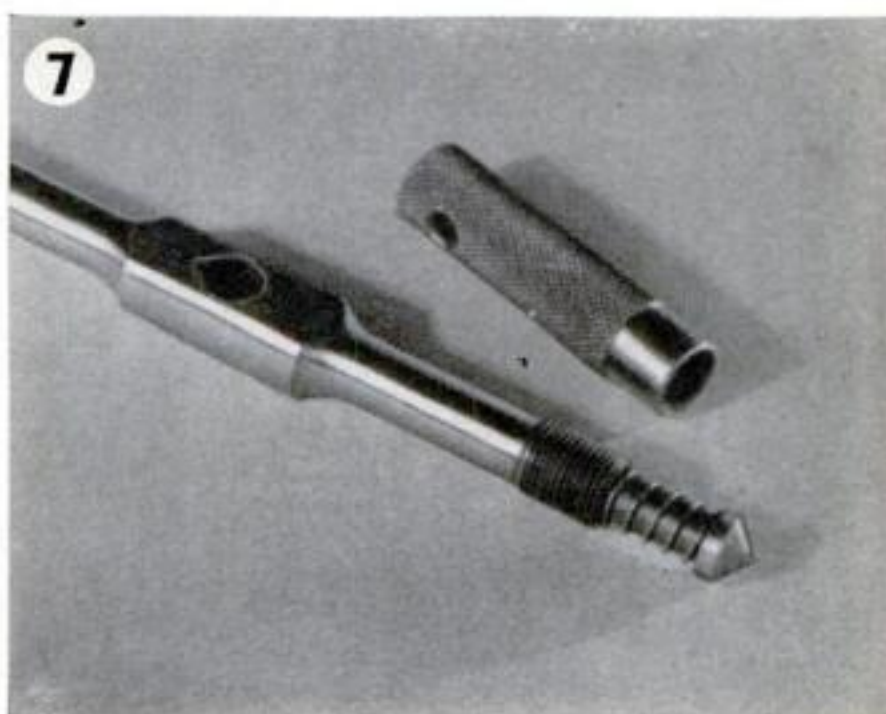
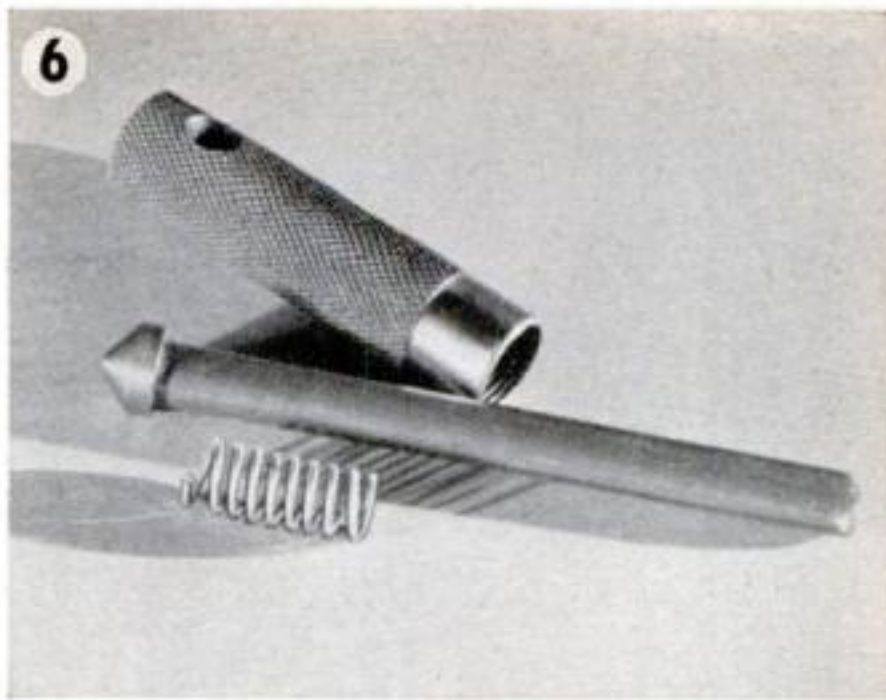
The body of the wrench is made from $\frac{9}{16}$ " by $\frac{3}{4}$ " tool steel. It is centerdrilled on one end and rough-turned to shape (Fig. 2). In Fig. 3 the threads are being





cut for the loose handle, and the end is also being drilled for the clamping rod. The hole to receive the tap shanks is drilled as in Fig. 4; note that it is slightly off center. The V-notch, which is filed in by hand, will center the hole.

The slot for the pin which holds the clamp rod in place is cut in the milling attachment (Fig. 5). The loose handle is turned to shape and knurled, and it is drilled and tapped at the same chucking. The clamp rod is next turned. Dimensions are given in the drawings. Figure 6 shows the finished handle with the spring and clamp rod; Fig. 7, the parts assembled.



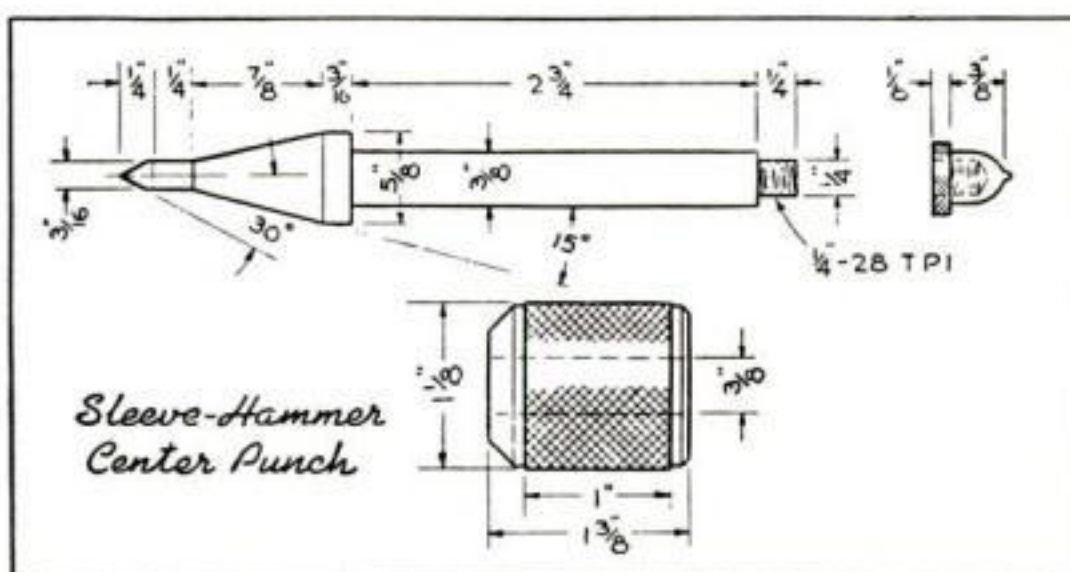
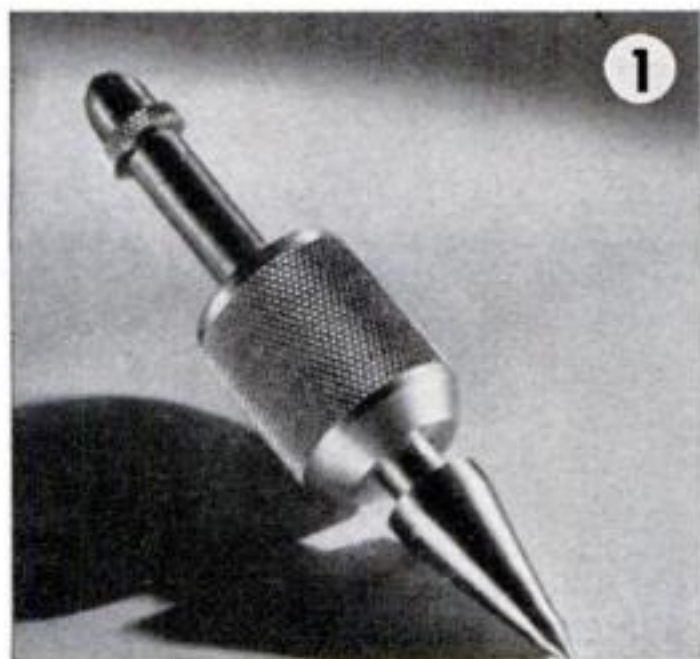
Sliding Sleeve on Center Punch Serves in Place of Hammer

THE construction of this center punch (Fig. 1) is such that the use of a hammer is unnecessary. A sliding sleeve is used as the driver. The punch will therefore be a welcome addition to the tools of the mechanic who has to do layout work within close limits.

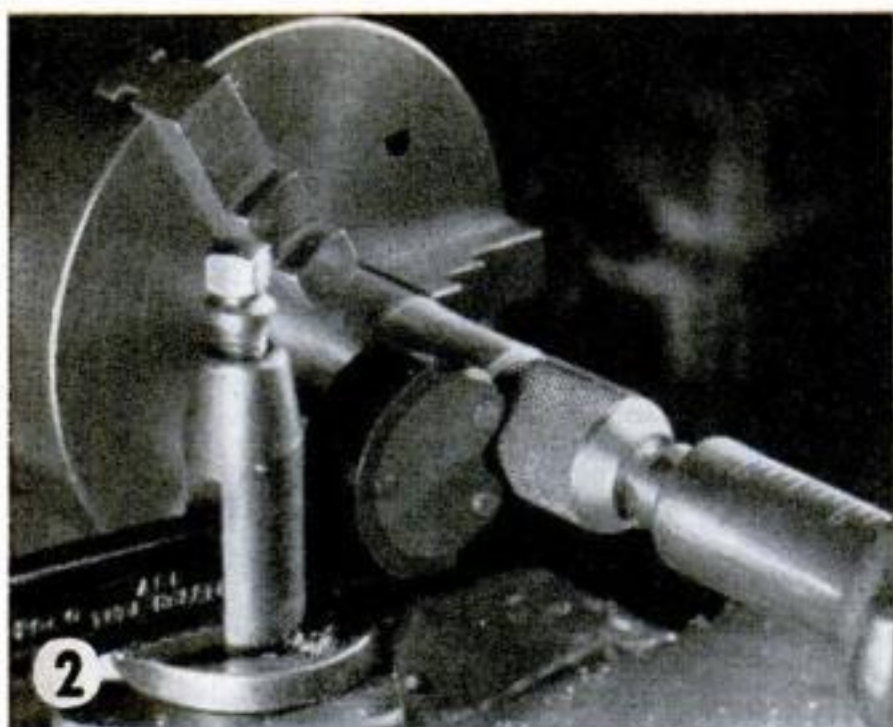
The center punch should be made from a good grade of tool steel, hardened and ground on the point. For the sliding-sleeve

hammer, however, less expensive machinery steel can be used. It should be $1\frac{1}{8}$ " in diameter.

Chucked in the lathe, the sliding-sleeve hammer is first centerdrilled and turned to shape, then knurled for a better handgrip as in Fig. 2. The hole for the center punch is drilled and reamed, and the finished part is then cut off with a parting tool as shown in Fig. 3. After this operation, the end



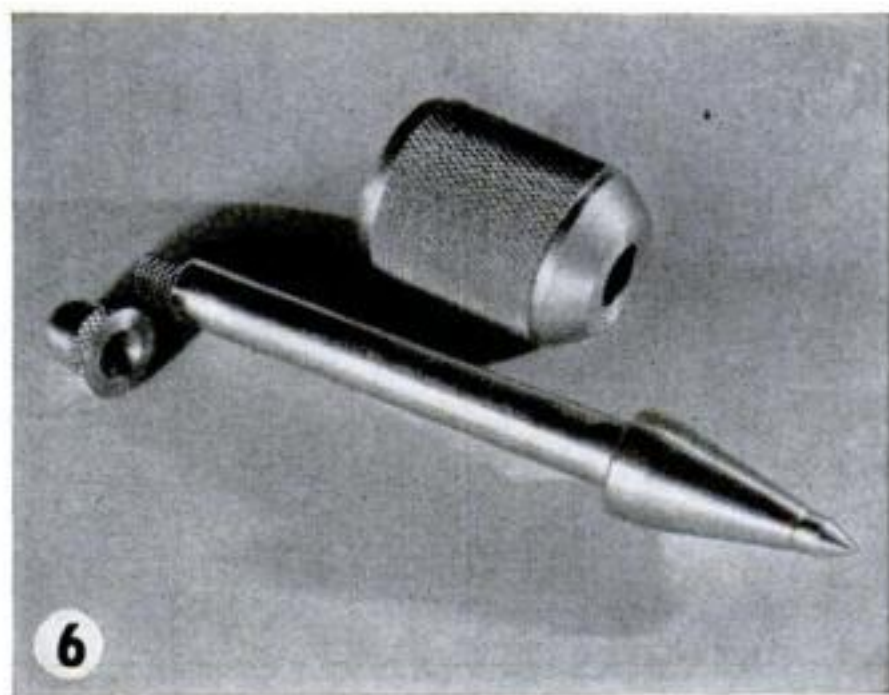
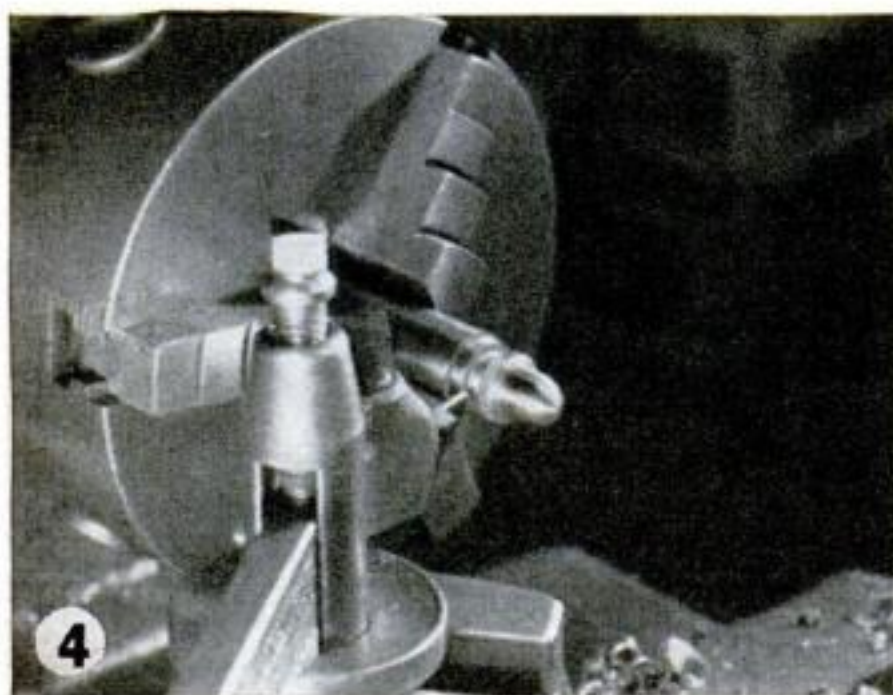
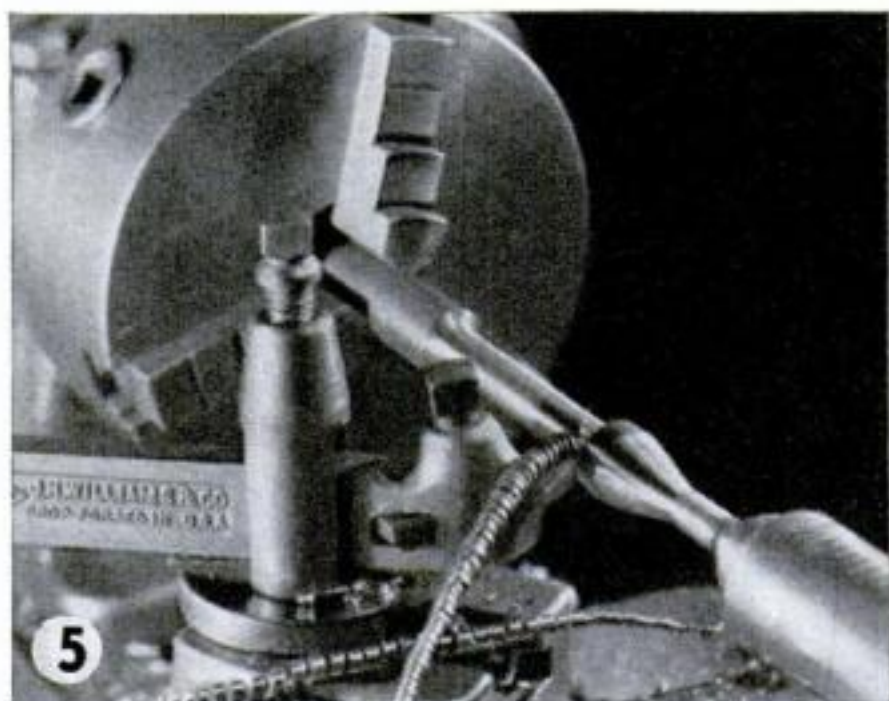
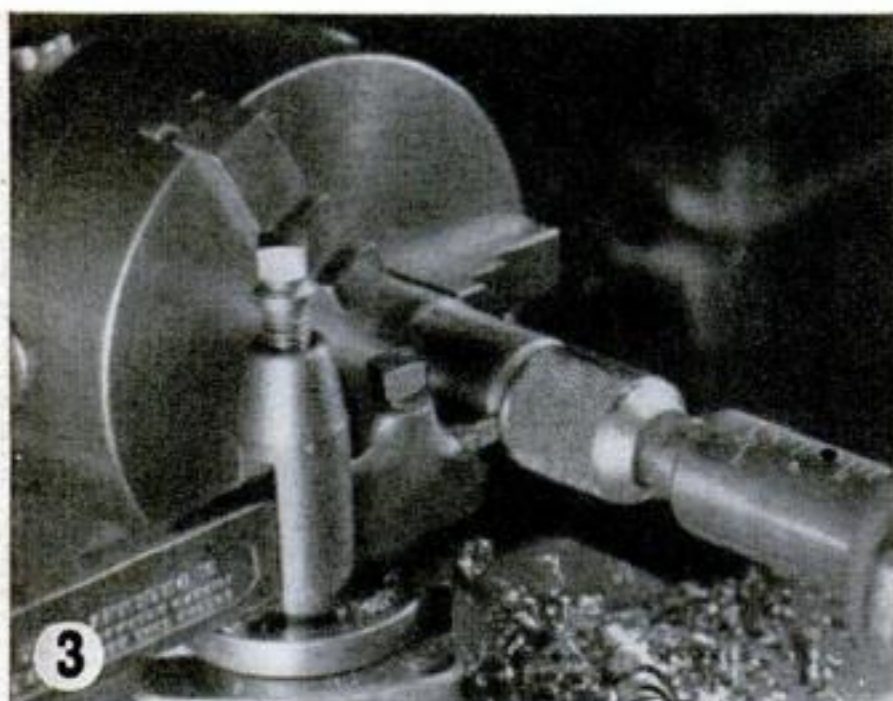
Dimensions for making center punch, cap, and sliding sleeve. All three parts can be turned from two small pieces of stock



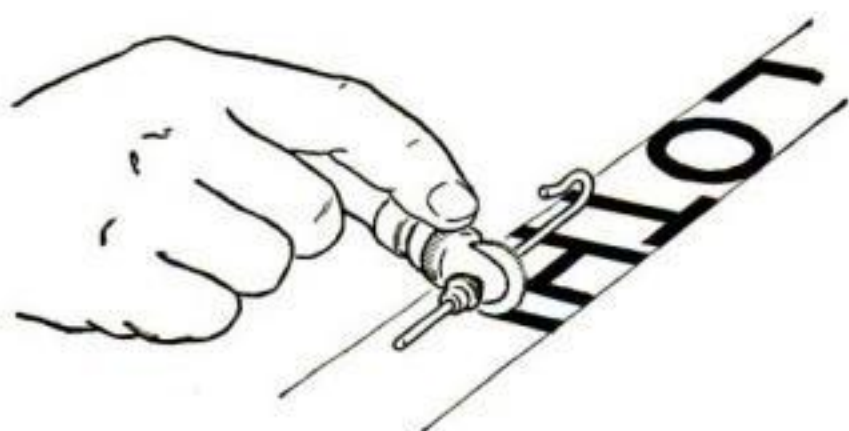
of the sliding sleeve is faced smooth.

In making the center punch, a $\frac{5}{8}$ " bar of tool steel is chucked as in Fig. 5 and centerdrilled for tailstock support. Then it is turned to the dimensions given in the drawing, cut off, and filed to a point in the lathe. Reverse it and thread the other end with a die for the cap. This is turned on the end of a rod as in Fig. 4; it is knurled and cut off, reversed in the chuck, and drilled and tapped $\frac{1}{4}$ "-28 to fit the end of the center punch.

Harden the head, then temper it to a straw color. Finish the point by grinding. The completed parts are shown in Fig. 6.

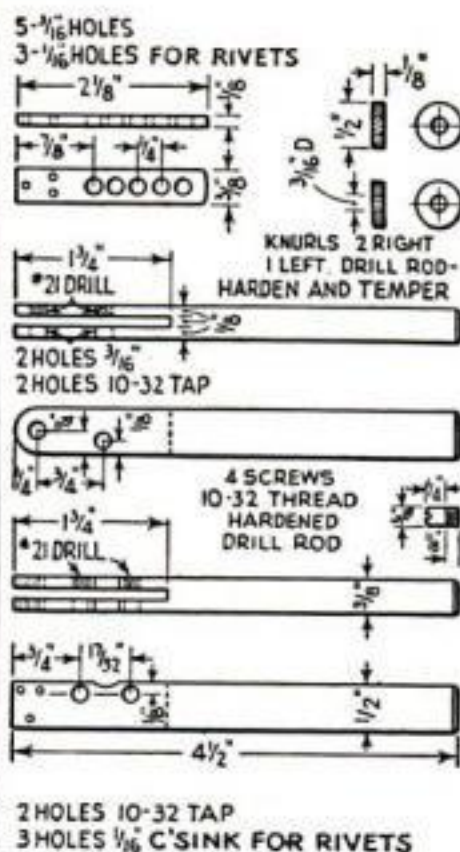
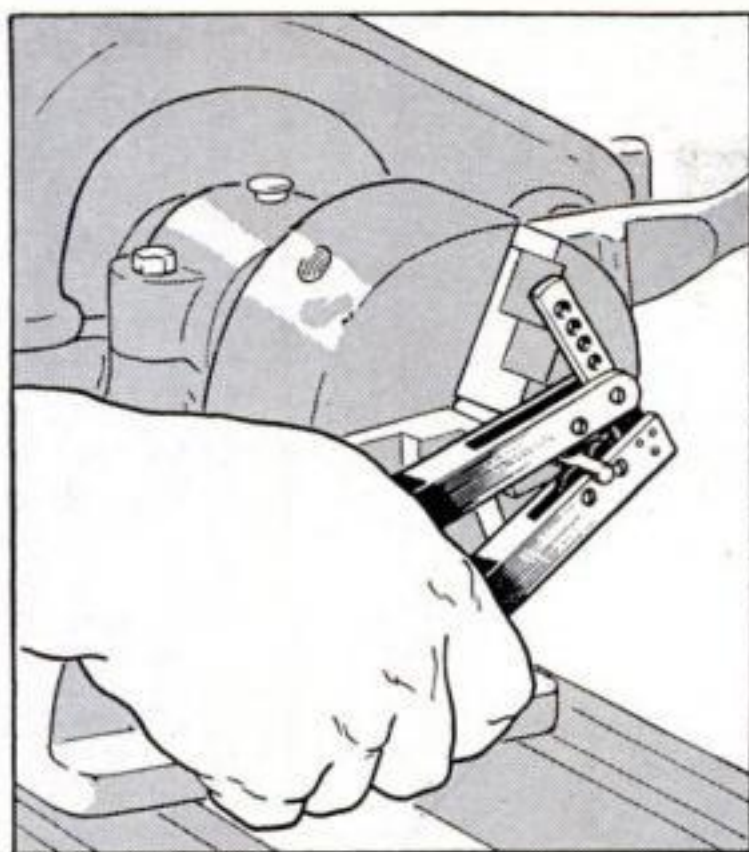


Paint Striper Big Help in Lettering Small Signs Neatly



NEATER, faster, and more uniform lettering can be done by the amateur sign painter with a small striper instead of a brush. The guide arm of the striper must first be removed or turned up out of the way. Sketch in the lettering with a pencil and go over it with the striper held like a pencil or pen. If the striping wheel is not as wide as the required letters, make parallel strokes until you have built up the necessary width.—EUGENE H. MORRISON.

Simply Made Nutcracker Tool Does Speedy Job of Knurling



TWIN-CARBON ARC TORCH

DOES PREHEATING, BRAZING, AND LIGHT WELDING

By WALTER E. BURTON

A TWO-CARBON torch of this type is a useful adjunct to the ordinary arc welder. It can be used for many jobs that would otherwise require a gas torch, and will do brazing considerably faster than a straight acetylene (nonoxygen) brazing torch, besides certain types of light welding for which a single-rod arc is unsuitable.

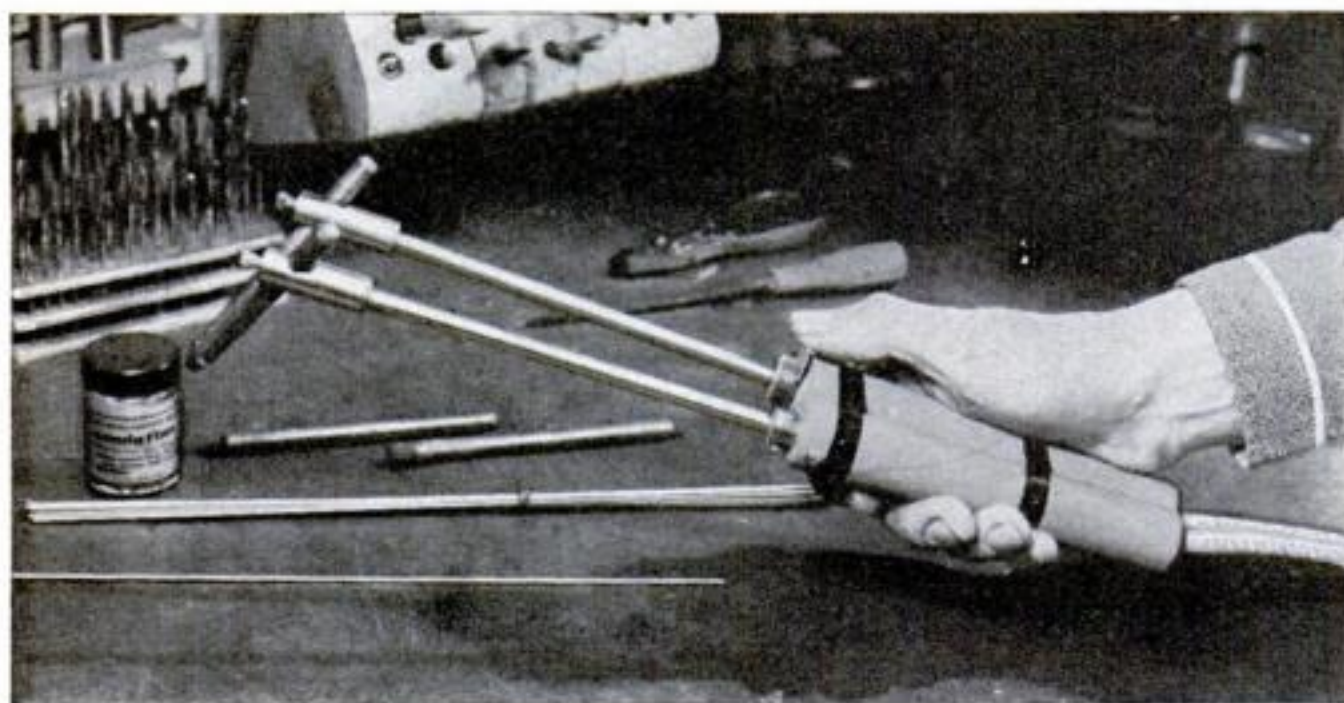
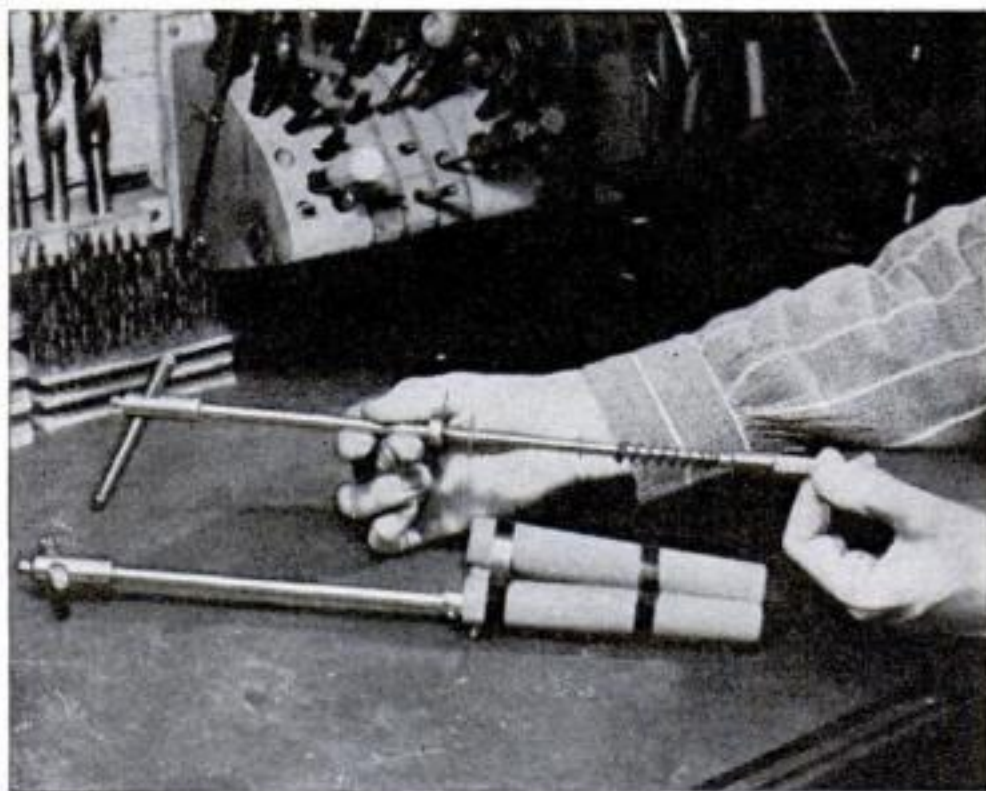
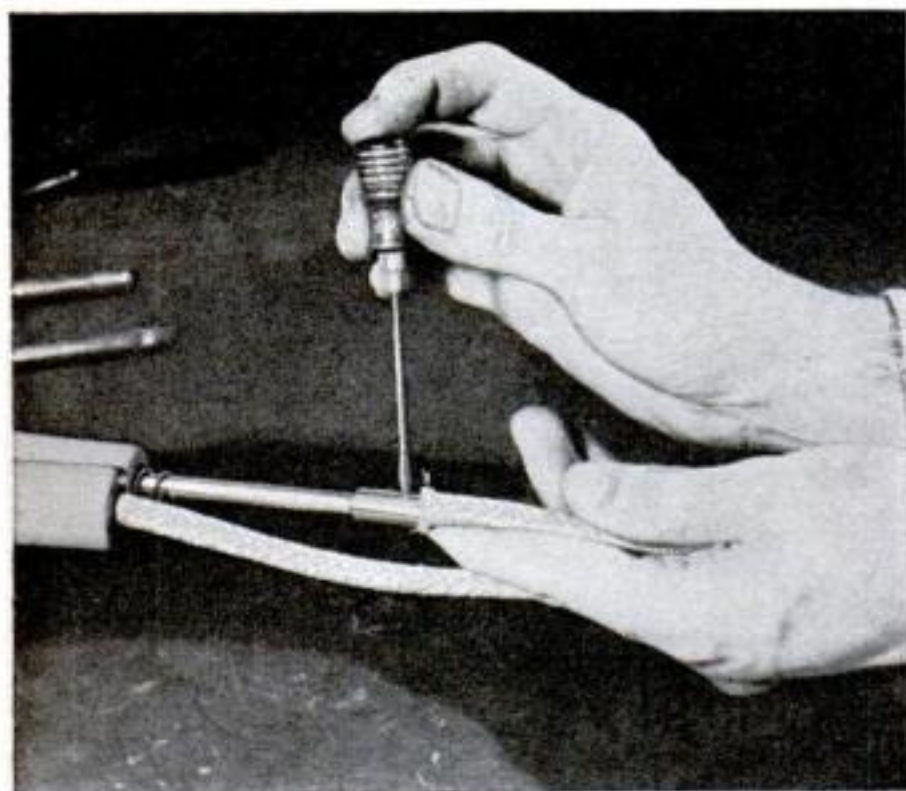
The materials required are: 2 brass rods $\frac{1}{2}$ " in diameter and $1\frac{1}{2}$ " long, and 2 brass rods $\frac{1}{4}$ " by 11"; 2 brass collars $\frac{5}{8}$ " in diameter, with $\frac{1}{4}$ " holes and set screws; 2 pieces 1" maple doweling $5\frac{3}{4}$ " long; several pieces $\frac{3}{8}$ " round brass rod; 2 set screws 8-32 and 2, 6-32; 2 coil springs to fit over the $\frac{1}{4}$ " rods; fiber, heavy stranded asbestos-covered cable, and miscellaneous nails, screws, and metal bands.

The $\frac{1}{4}$ " rods are threaded $\frac{1}{4}$ "-20 at both

ends, and the two pieces of $\frac{1}{2}$ " rod tapped the same at one end, and tapped at the other to receive the 8-32 set screws. The $\frac{17}{64}$ " holes for the carbons are drilled at an angle of about 70 deg.

Centerdrill two $\frac{3}{4}$ " lengths of the $\frac{3}{8}$ " rod with a No. 7 drill and tap one end of each $\frac{1}{4}$ "-20. Ream or counterbore the other ends to receive the cable. Drill and tap a small hole radially for a 6-32 set screw to hold the cable.

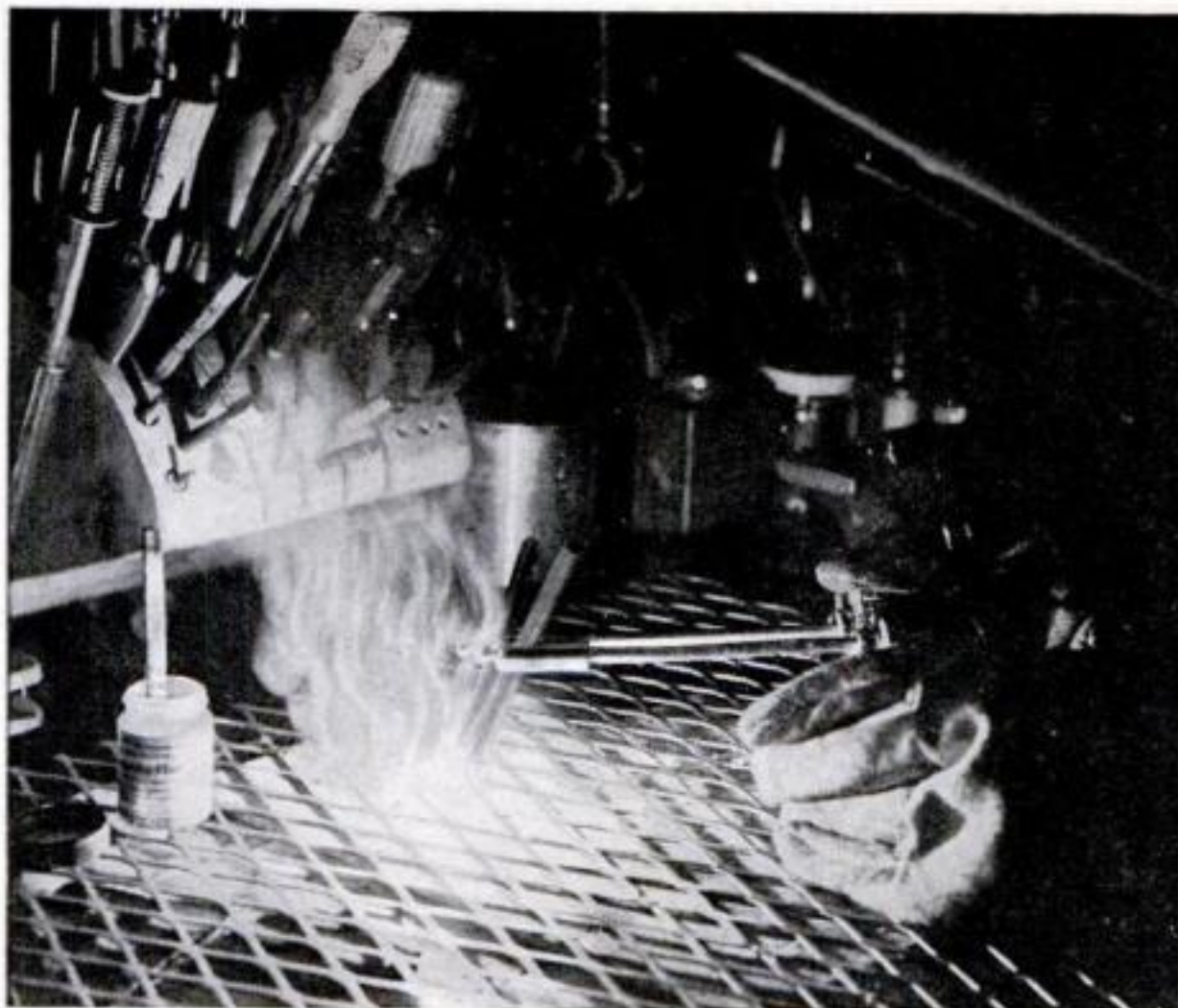
The handles may be made of fiber or composition rod instead of maple doweling, if the builder prefers. They are bored lengthwise with a $\frac{1}{4}$ " bit, then counterbored $\frac{1}{2}$ " to a depth of $2\frac{1}{4}$ ". Sand or file a flat spot at the counterbored end of the pieces so that they may be glued together to form a narrow "V." Glue a small block between the opposite ends, and nail or screw on two metal reinforcing strips as shown.



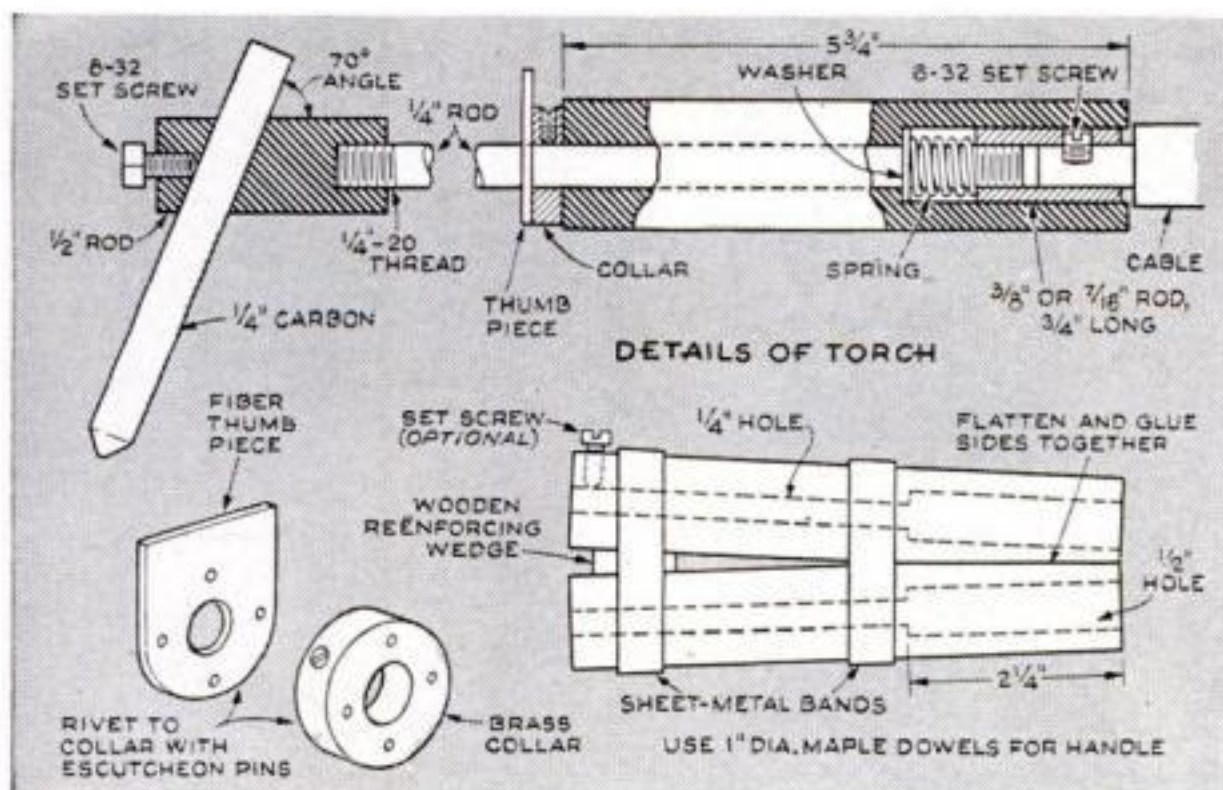
Above, left, attaching heavy asbestos-covered arc-lamp cable to one of the cable connectors

Above, right, assembly of movable rod, showing spring and fiber thumb piece riveted to collar

At left, the assembled torch. To strike an arc, touch carbons together by turning thumb piece, then separate them just a fraction of an inch



The torch in use, brazing together pieces of steel netting. The arc is guided over the work much like the flame of a gas torch. Below, the construction drawings. For heavy-duty work, increase the size of the parts and add heat-radiating fins to the shafts



To one of the brass collars rivet the fiber thumb piece. Slip this on one shaft, slide the latter through one handle, and put on a washer and a spring as illustrated. Screw the cable connector fast. Attach the cable, and pull the shaft against the tension of the spring until the cable enters the handle. Then tighten the brass collar in place.

After assembling the other rod, adjust both so that the tips of the carbons will be in the position shown in the photographs when the torch is held in the hand. It should be possible to rotate one rod by means of the fiber piece with the thumb. The other rod can be locked in the proper position by thread-

ing a 6-32 set screw directly into the handle, as shown.

The 70-ampere arc-lamp cable sold by theater-supply stores is suitable for connecting the torch. This cable has an asbestos covering, which may be rendered more durable by coating it with spar varnish. However, No. 6 stranded 60-ampere cable will also do.

Carbons $\frac{1}{4}$ " in diameter are suitable for most work, and these may be obtained from welding supply houses. The cored type should always be used for alternating current. Some authorities recommend metal-sheathed carbons, which seem to differ only in that they do not get red-hot as far back from the tip as the unclad type.

If a welding transformer is not available, the torch can be used with a resistance unit on the 110-volt lighting circuit, provided that the mains are heavy enough to carry a 20-ampere load. The resistor can be made from two or four standard electric-heater elements. If only two are used, they must be altered as shown in the drawings.

Remove the coiled wire, locate its approximate middle point, and silver solder to it a $2\frac{1}{2}$ " piece of No. 14 bare copper wire. Rewind the coil on the porcelain spool and mark the location of the soldered lead. Drill a hole through the spool at this point, using a small drill bit sharpened to a long point. Thread the copper lead through the hole and connect it to the center terminal in-

side the spool. The ends of the resistance wire are connected together with a second piece of No. 14 copper wire and to the threaded jacket on the base. This alteration permits each element to pass four times the current it originally did.

Mount two porcelain sockets on a base with a 10-ampere switch to short out one of them. Cable clamps can be made from $\frac{3}{8}$ " brass rod as illustrated. It may be well to shield the cable from heat by placing a collar of asbestos paper around the socket of the nearer element.

If four elements are used, they need not be altered, and the incidental heat is more

readily dissipated. With the two-switch arrangement shown, an intermediate current can be obtained. Either unit may be cooled by directing an electric fan against it.

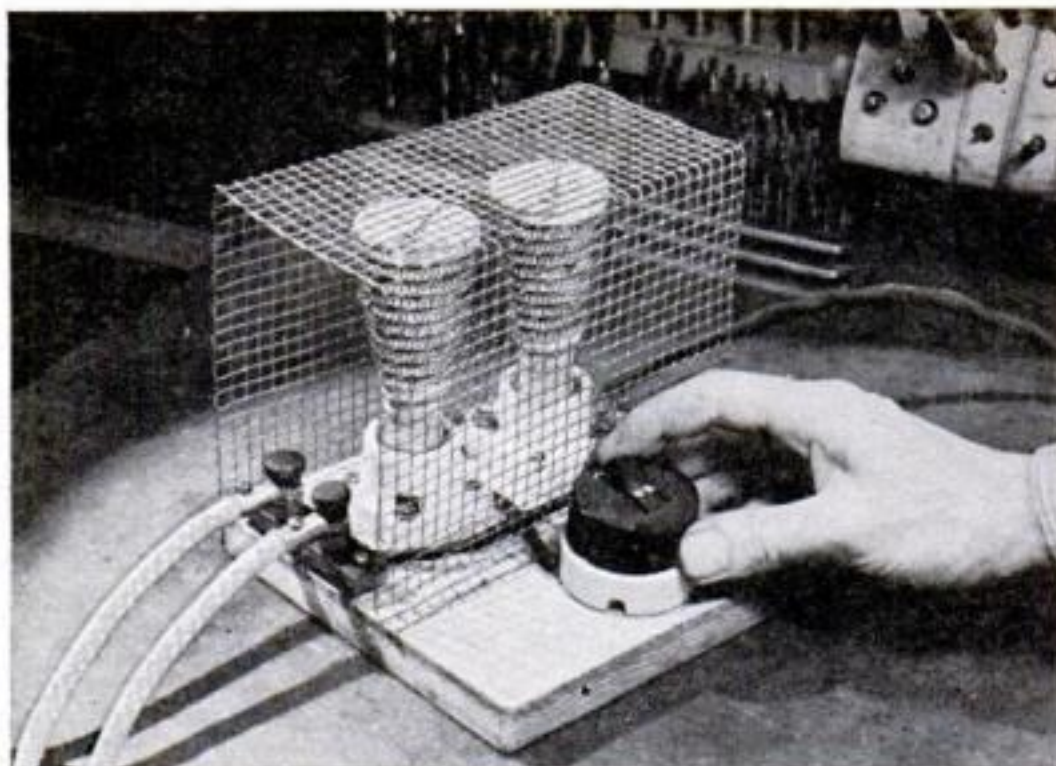
To strike the arc, bring the carbon tips together, then separate them a fraction of an inch. On a welding transformer, operate the torch at the lowest heat that will give an arc resembling a gas flame.

Aluminum welding should be done on a low-amperage tap, and some practice will be necessary to avoid burning the metal. Use a suitable flux and regular aluminum welding rod.

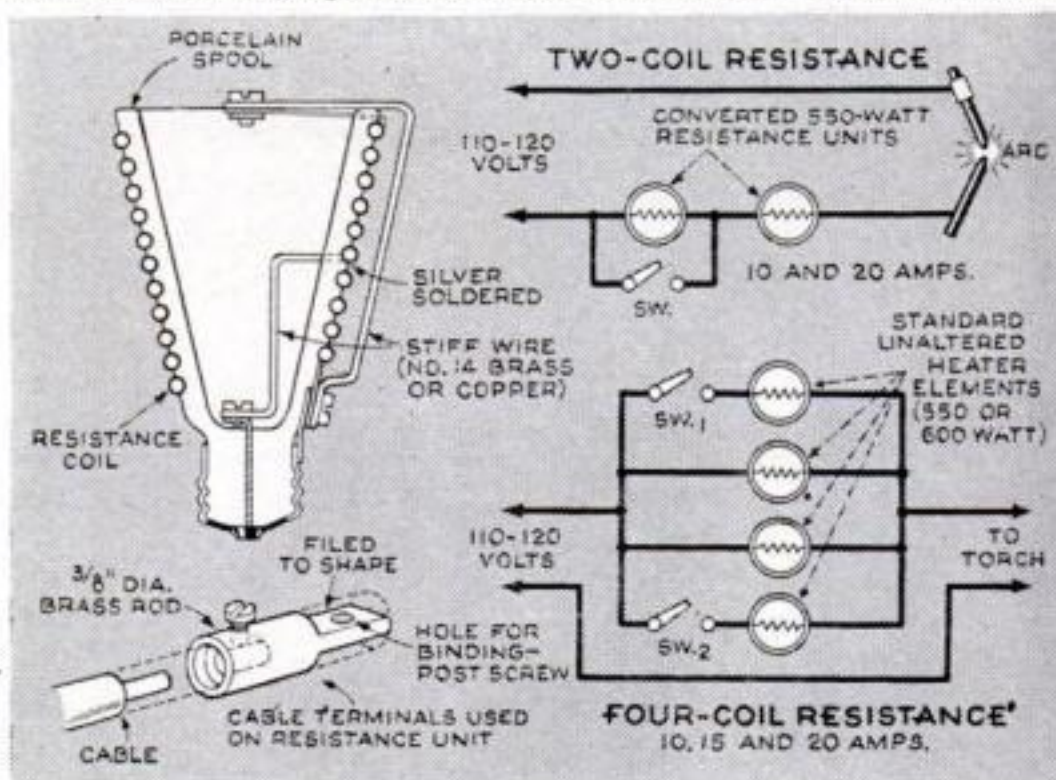
In doing hard or soft soldering, as in brazing, be sure to heat the work enough before applying the solder.

No electric welding equipment should ever be used without protection from the powerful ultraviolet rays the arc produces, to which no bare skin whatsoever should be exposed. Wear a welding helmet fitted with an approved window, and heavy gloves reaching well up on the wrists.

This torch is substantial enough for fairly heavy intermittent work. For heavy-duty operation the parts should be made heavier, and radiating fins can be added to the shafts to help dissipate heat before it reaches the handle.



Where no welding transformer is available, or on direct current, the torch may be connected through a simple resistance unit. Make a wire guard for the elements from hardware cloth



CARBON WELDING ELECTRODES

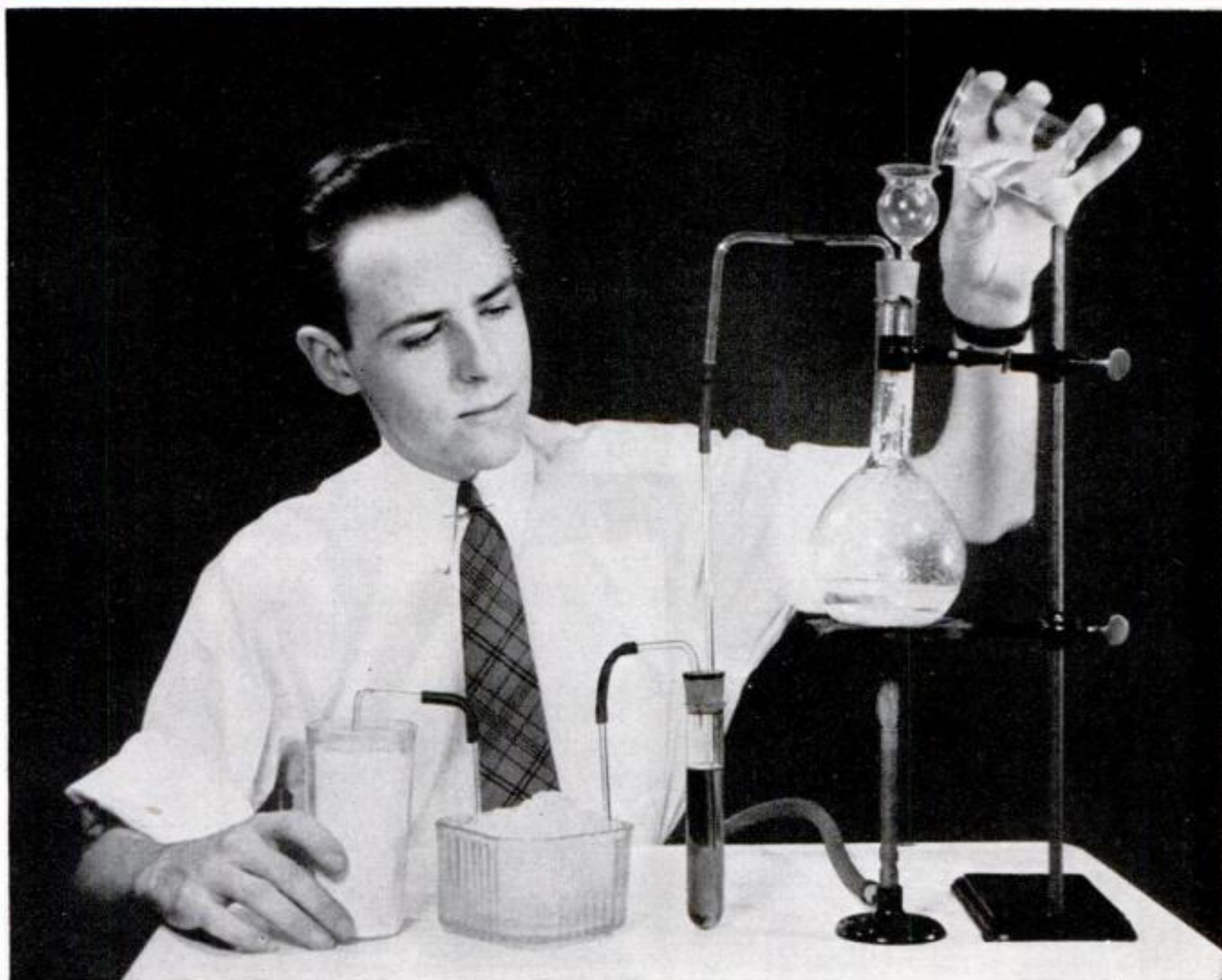
[METAL WORKING]

Cored carbon electrodes for use with alternating current contain materials that make it easier to hold an arc and afford a long, hot-tail flame when used in torch-type holders. Cored A.C. electrodes are available in diameters of $\frac{3}{16}$ ", $\frac{1}{4}$ ", $\frac{5}{16}$ ", $\frac{3}{8}$ ", $\frac{7}{16}$ ", and $\frac{1}{2}$ ", and in lengths of 6", 8", and 12". The following are the recommended amperages for various sizes of A.C. electrodes:

$\frac{1}{4}$ "	diameter	—	5 to 30	amperes
$\frac{5}{16}$ "	"	—	20 to 50	"
$\frac{3}{8}$ "	"	—	40 to 80	"
$\frac{1}{2}$ "	"	—	75 to 125	"

POPULAR SCIENCE MONTHLY SHOP DATA FILE

HOME EXPERIMENTS EXPLAIN THE MAGIC OF Cold from Chemistry



A miniature refrigerating plant: Heating a mixture of sodium sulphite and sulphuric acid produces sulphur dioxide gas, which is liquefied by passing through a tube buried in a bowl of ice and salt

By **KENNETH M. SWEZEY**

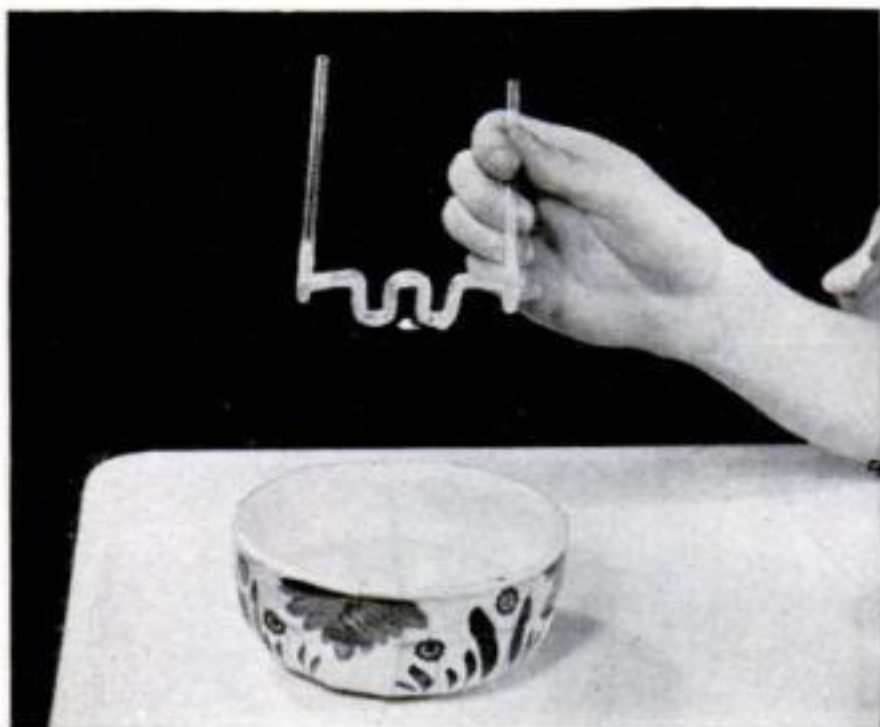
CAN YOU explain the mystery of the mechanical refrigerator in your kitchen—how a tiny gas flame, or a purring motor, turns heat into cold? Do you understand why “quick-freezing” of foods—is superior to old methods of slow freezing? Do you know the principle underlying “magic” powders which, when mixed with water, provide cold for picnics, cooling drinks, and first-aid compresses? With simple apparatus and chemicals, you can demonstrate refrigeration, concoct your own magic cold powders, and explain the efficacy of new freezing methods.

The principle of all so-called mechanical and thermal refrigeration is simple. A liquid that boils or vaporizes at a low temperature is changed into a gas or vapor.

In making this change it cools the air or other substance surrounding it by absorbing heat.

Ammonia is the refrigerating fluid, or refrigerant, used in nearly all ice-making plants and large packing houses. For smaller installations, sulphur dioxide, carbon dioxide, methyl chloride, and other compounds have certain advantages. For experiments in the home laboratory, sulphur dioxide is probably the easiest refrigerant to make and deal with, as the gas may be liquefied at ordinary atmospheric pressure by merely cooling with an ice-and-salt mixture.

Arrange your apparatus as shown in the photograph. Put a little sodium sulphite in the flask and add water until the sulphite is just covered. By heating this mixture gently, while adding concentrated sulphuric acid to it drop by drop, a steady supply of sulphur dioxide gas will be generated. To



When the cooling tube is removed from the ice and salt, frost forms on it as the liquefied sulphur dioxide is changed back into a gas, absorbing heat



You can make your own "magic sand with a thirst." Acid mixed into sodium silicate (water glass) forms a jelly that, when dried properly, is silica gel



Boric acid crystals formed slowly (at left) and by rapid crystallization. Quick-freezing keeps foods fresh because it makes small, regular ice crystals that do not appreciably alter the cell structure

free the gas from water vapor, it should be allowed to bubble through the test tube containing concentrated sulphuric acid before passing on to the cooling tube, an ordinary U tube, or one bent as shown in another illustration, packed in a dish of cracked ice mixed with salt. To absorb most of the gas which is not liquefied, the outlet of the cooling tube is connected to a tube imbedded in a jar of silica gel, the "magic sand with a thirst" recently described in *POPULAR SCIENCE MONTHLY*.

You can prepare silica gel yourself. Pour slightly diluted sulphuric or hydrochloric acid into a solution of sodium silicate (water glass). Shake or mix as you pour, until the solution has completely changed into a jelly-like mass. Break this up with a glass rod, and wash the mixture with water several times, allowing the insoluble silica gel to settle and pouring off the water above it. After washing, the gel should be thoroughly dried in an evaporating dish or in the stove oven.

Now you are ready to generate and liquefy your sulphur dioxide. Only slight heat should be used, to avoid too violent a reaction. After several minutes, inspect the cooling tube. It should contain a few drops of liquefied sulphur dioxide. As some of the gas is bound to escape in the room, it is best to work near an open window.

When you have made enough liquid sulphur dioxide, turn out the burner, disconnect the ends of the cooling tube, and remove it from the ice mixture. Now rinse it quickly in clean water to remove the salt solution, and hold it for a moment in the air. Instead of getting warmer, the tube gets so cold that frost forms on it! The liquid sulphur dioxide is now boiling away



Model of thermal cooling system used on many refrigerated railroad cars. Silica gel saturated with sulphur dioxide is heated to drive out the gas, which liquefies when cooled in the other tube

—changing back into a gas— and as long as this goes on, the tube will be cold.

The reaction you observe is exactly that which takes place in the cooling compartment of your refrigerator, regardless of its type.

In mechanical refrigerators, reliquefying is accomplished by compressing the vapor and then cooling it with an air blast or cold water. In thermal machines, the vapor is taken up by water or silica gel. It is then driven out again by heat and liquefied by passing through pipes cooled by air or water.

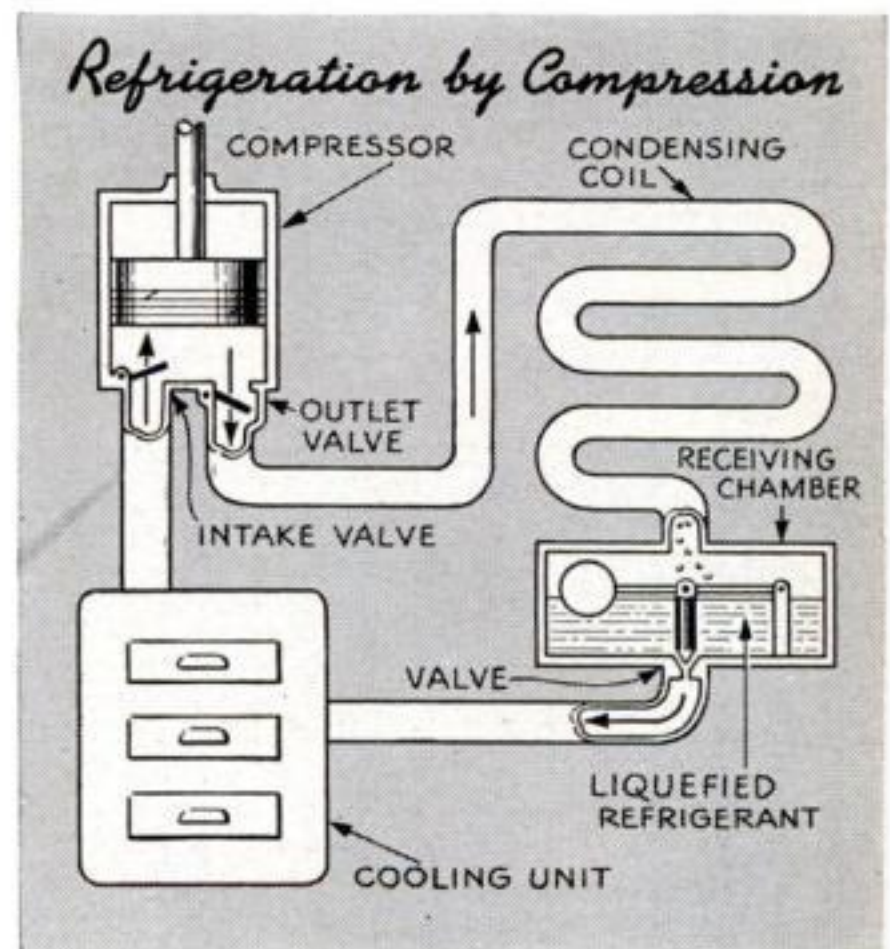
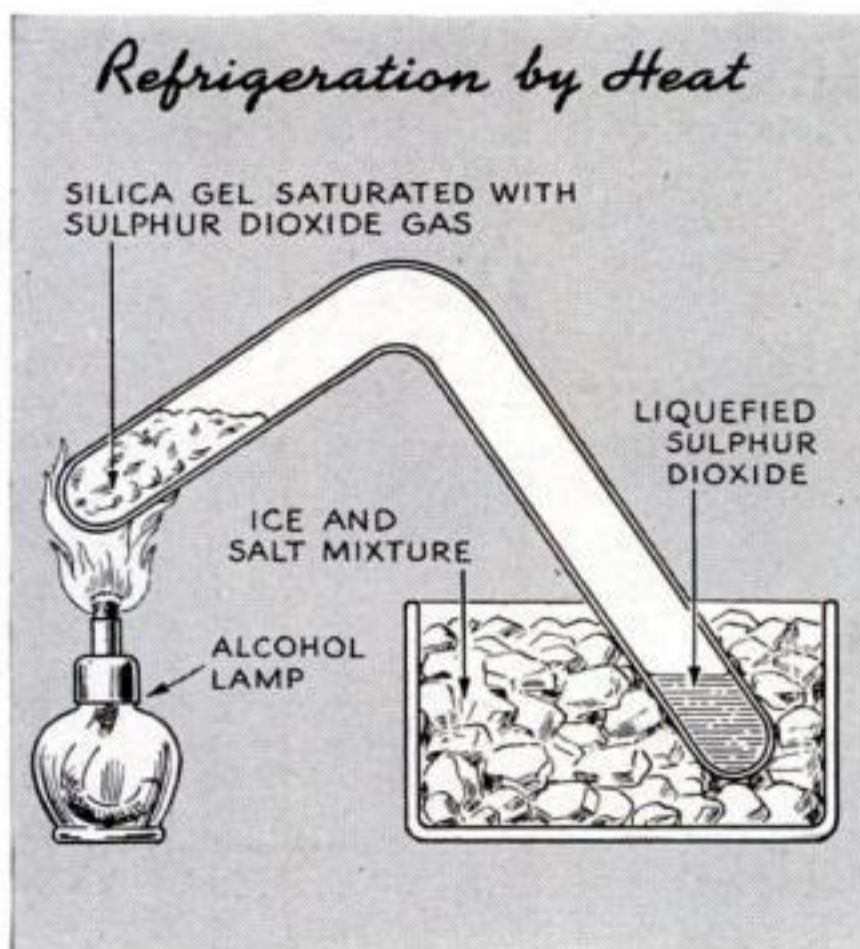
For another simple experiment, which demonstrates a thermal refrigerating system used widely on refrigerated railroad cars, we use silica gel saturated with sulphur dioxide—which is the exact combination used on the car systems. The apparatus is constructed from two test tubes, joined as shown, and with their stoppers tied in. To exclude water vapor, the silica gel should be thoroughly dried before it is saturated with the sulphur dioxide gas. Heat drives the gas into the cooling tube where it is liquefied. When allowed to become a gas again, it produces a refrigerating effect.

The secret of "quick-freezing" is a matter of crystal formation. Make a saturated solution of boric acid crystals in hot water. Pour half the solution in one test tube, and



"Magic" powders produce cold when dissolved in water. Equal parts of ammonium nitrate and sodium carbonate (washing soda) mixed into a similar amount of water at 50° chills the liquid to about -7°

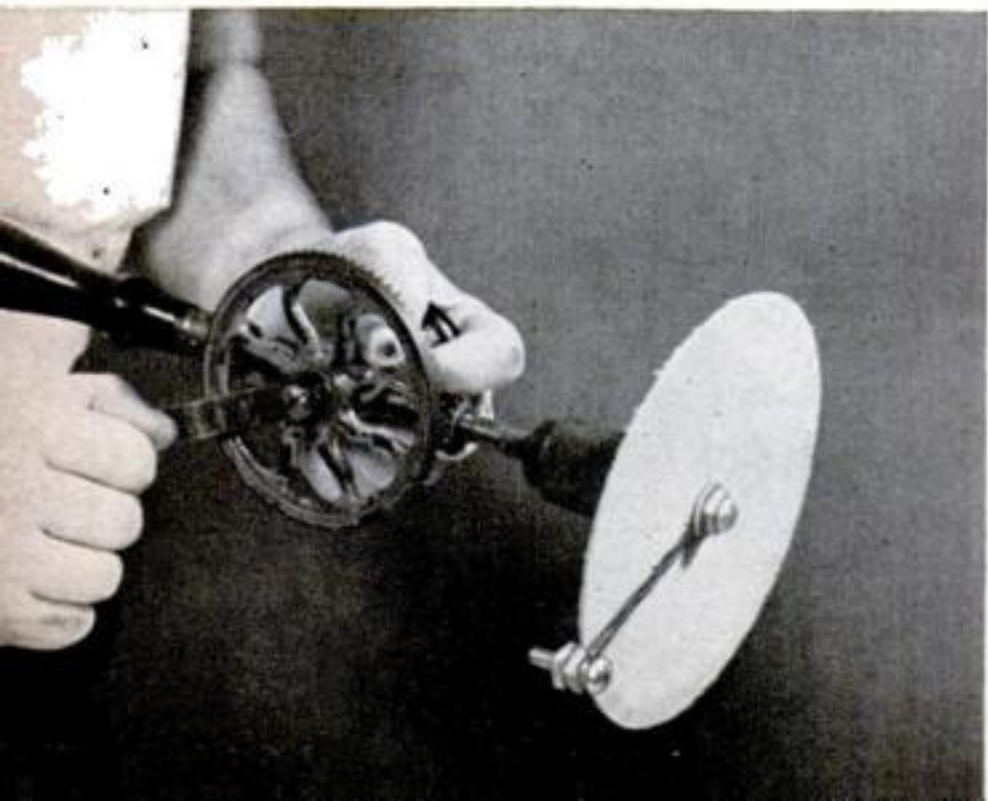
half in another. Now plunge one tube into cold water, to cool it quickly, and allow the other tube to cool normally in the open air. When both have thoroughly cooled, you will discover that the crystals formed in the tube that was cooled slowly are much larger and less regular than those formed in the tube that was cooled quickly. When foods are frozen quickly, the ice crystals formed are so small that they do not appreciably alter the cell structure of the food. On the other hand, the large crystals formed by slow freezing often mutilate the food and change its character.





HOW GRAVITY AFFECTS A PENDULUM. At different points on the earth's surface, the pull of gravity is not the same. It is greater near the poles than at the equator, because the polar caps are nearer the center of the earth; and there the increased force of grav-

WHY WE STICK TO EARTH. With rubber bands, attach nuts and bolts to the rim of a cardboard disk, and whirl the disk as shown. Suppose the bolts represent people and houses at the equator; the rubber bands, the force of gravity. If you spin the disk fast enough, centrifugal force will overcome gravity, and the bolts will fly off. That is just what would happen to objects at the equator, if the earth turned at comparable speed. Luckily it doesn't. Its plodding pace of little more than 1,000 miles an hour would have to be multiplied about 17 times. Above and below the equator, the earth's slower gait favors gravity even more.

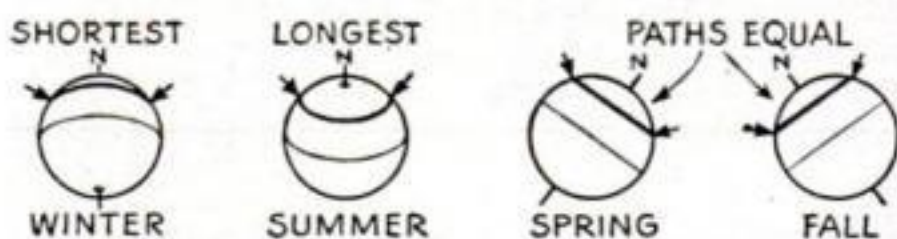


EASY TESTS SHOW THIS EARTH

OBLIVIOUS to commotions that men make upon its surface, the planet Earth rolls on in its orbit—and mere mortals must submit to the dictates of celestial law. Blackouts lengthen as days grow shorter. General Mud and General Snow, in their seasons, upset mighty

it will make a pendulum swing slightly faster. To show this, suspend a small piece of iron from a string and place the pole of a strong electromagnet just beneath. Swing the pendulum, first without and then with current in the electromagnet. You will find the pendulum swings faster in the second case, while the magnet is simulating the effect of added force of gravity and increasing the acceleration of the pendulum bob. Of course, for a fair comparison, a pendulum of identical length must be used for each experiment—for the time of swing of a pendulum is normally determined by its length.

WHY DAY'S LENGTH CHANGES. Mark a spot in the United States on a small globe, set up as in photo below. Close one eye, turn the globe, and you will see the mark for less than a half turn. Reverse the stand, and the mark will be visible for more than a half turn. At right angles, it will be seen for just a half turn. In this test, your eye represents the sun; the time you see the mark, the length of day at different seasons.

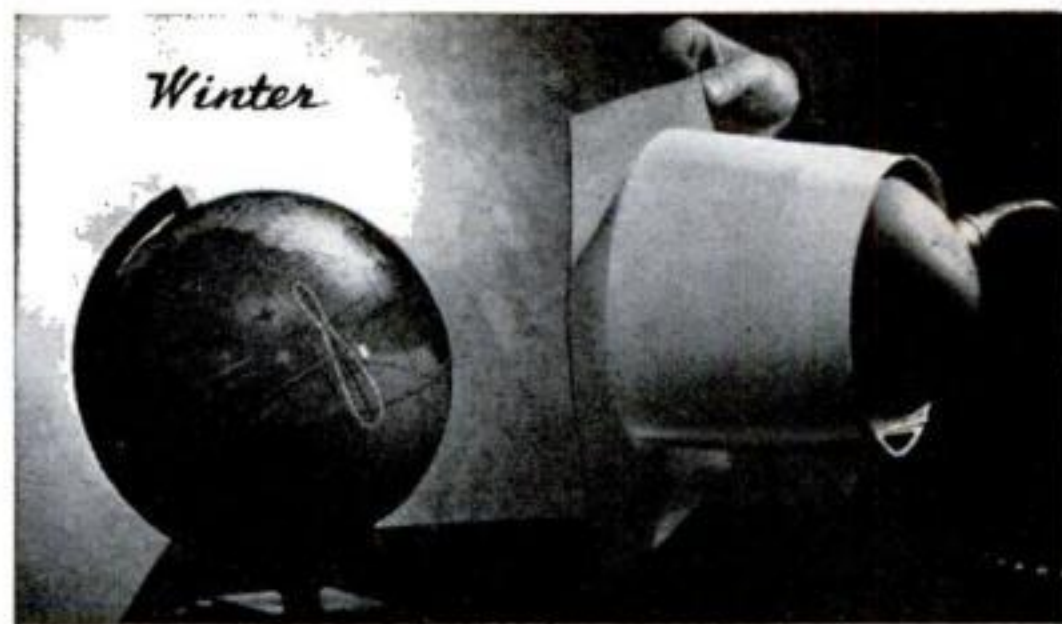


ODD FACTS ABOUT WE LIVE ON

war engines. Weather reports are censored—but no one can suppress the workings of the giant machine on which we live. Here are six illuminating home experiments that show the reasons for seasonal changes and other mysterious habits of our spinning home.

WHY SUN'S HEAT VARIES. When it's summer in North America, the sun has climbed farthest north, and its rays strike northern latitudes squarely. In winter, the sun retreats south of the equator, and its slanting rays "thin out" to spread over a greater northern area, as may be shown with a lamp, a cardboard window, and a globe. That curious little 8-shaped figure on the globe, called an analemma, shows the extremes— $23\frac{1}{2}$ degrees north and south—of the sun's overhead travel. It may be seen that our good neighbors in South America are always having exactly the opposite season from our own.

YOUR WEIGHT AT CENTER OF EARTH. If you could manage to get to the middle of the globe, your weight would dwindle to zero! So long as you're *outside*, gravity pulls you just one way—down. But a cardboard ring, a washer, and four elastics tell the "inside story." Like the washer, whose rubber bands simulate opposed forces of gravity at the earth's center, you would float freely. Assuming the place filled with air, you could swim in it. If you started up a ladder, surrounding forces eventually would be unbalanced and tend to draw you back, as demonstrated below—but the first part of the climb would be as easy as lifting a feather.



In our winter, the sun's rays strike the Northern Hemisphere slantwise, as in the upper set-up. In summer, they hit squarely and so give more heat

MEASURING HOMEMADE 'QUAKES. To demonstrate the principle of the seismographs that record earthquakes, attach a weight near one end of a long rod, which is pivoted against a stand as shown. It should freely swing sidewise. To the outer end of the rod, fasten a bit of wire to serve as a recording needle. Now start drawing a piece of smoked paper under the needle, at the same time jarring the table slightly. You will obtain a record showing, in wavy lines, the jiggling of the table. The costly instruments of scientific institutions work in much the same way, although of course with much higher precision.



Superhet for Beginners

USES ONLY TWO TUBES

By ARTHUR C. MILLER

SEVERAL years ago, a superheterodyne receiver had to consist of at least seven tubes—sometimes nine, for in those days the multiple tubes we use so frequently in our present sets had not been perfected. A two-tube super is possible these days, and one of them is shown on these pages.

A 1A7GT pentagrid tube is used as the first detector and oscillator. A two-gang .00036 condenser tunes these two stages. To insure proper tracking of the oscillator tuning condenser a fixed mica condenser with a capacity of .0004 mfd. is wired in series with the oscillator coil. This condenser must be accurate within ± 3 percent.

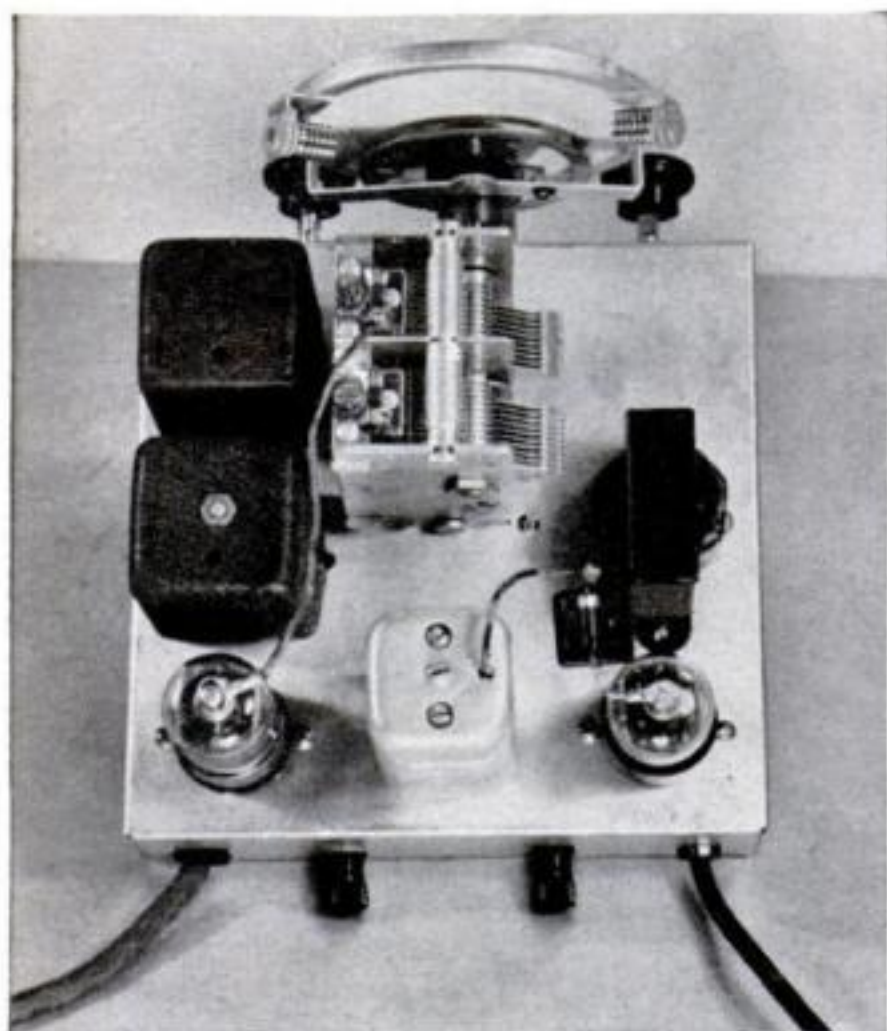
Across the other tuning condenser (in parallel with it) is a low-capacity (.00005 mfd.) midget variable trimmer condenser. This is adjusted to compensate for any irregularities between the two tuning condensers. It is not necessary to adjust it for each station.

The output of the 1A7GT is coupled to the detector stage through a 456-kc. I. F. transformer (this may be either an iron-

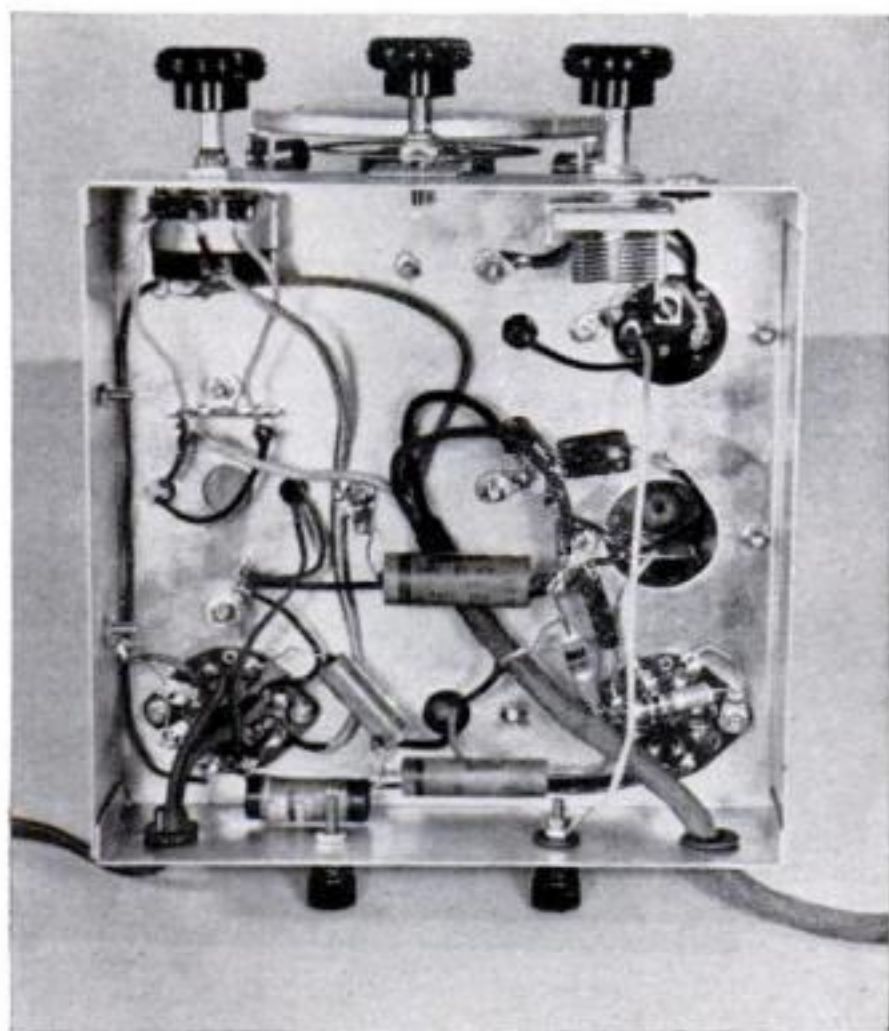


This two-tube superhet gives loudspeaker reception of local stations with a 20-foot antenna laid on the floor

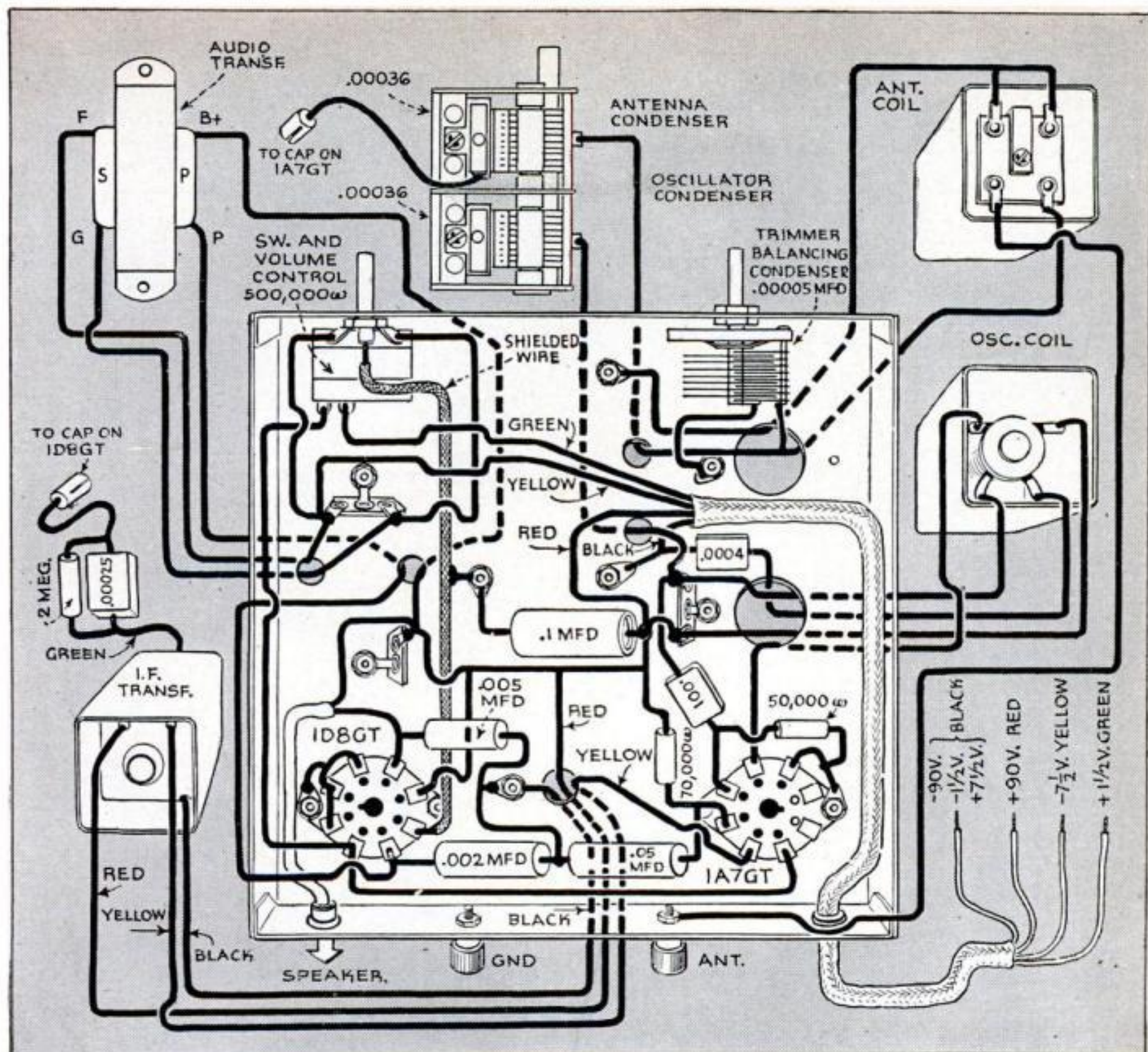
core or air-core type). Both primary and secondary windings of the I. F. transformer are tuned by tiny built-in trimmer condensers which have to be adjusted before the receiver will operate. This may easily be done by tuning in the strongest local signal and turning the two screws on top of the



Topside of chassis, showing the two multiple tubes that do the work once performed by seven or more

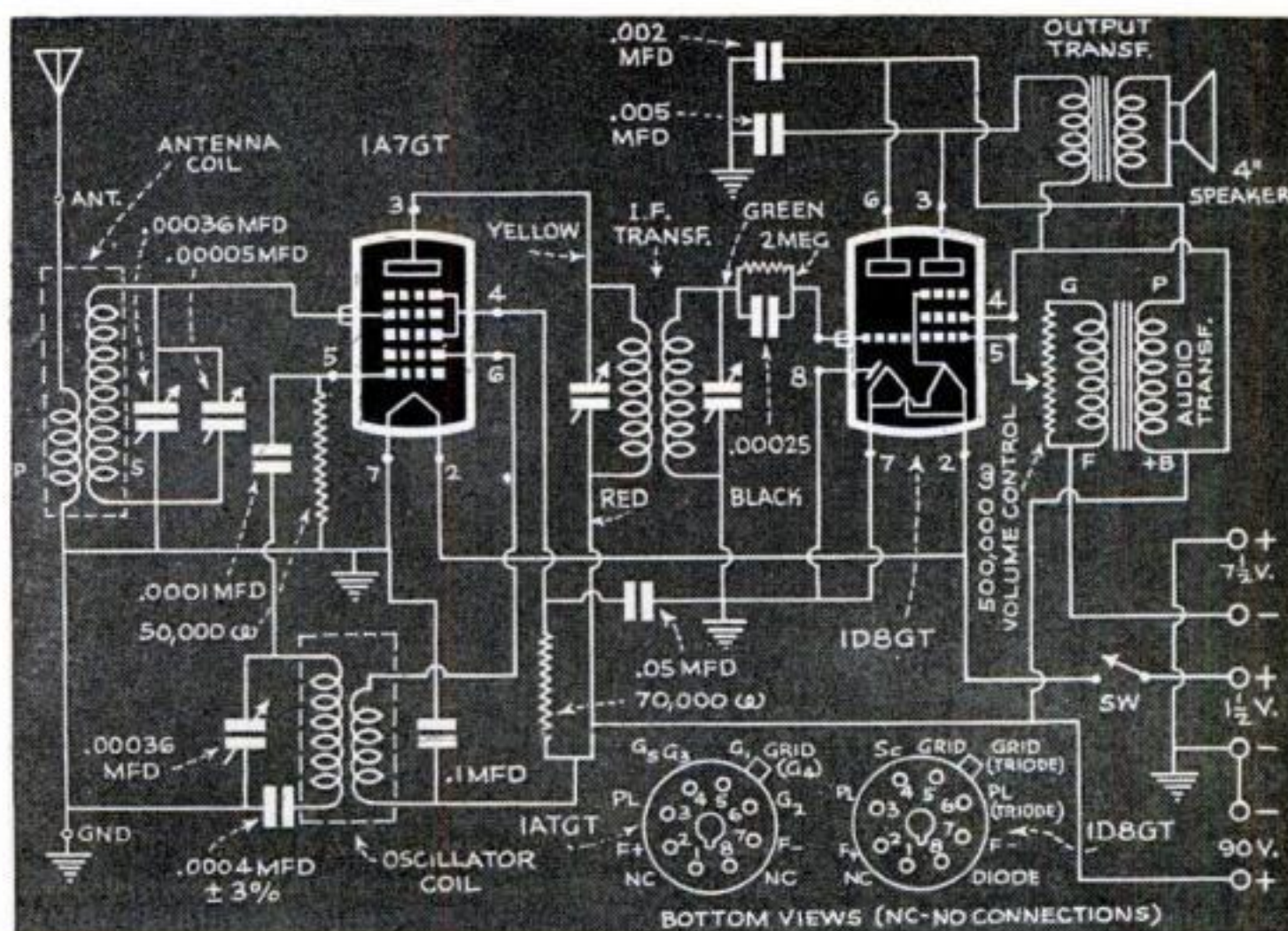


This is the underside of the chassis. The on-and-off switch is operated by the volume-control knob



As shown in this pictorial diagram, the 1A7GT pentagrid tube is used as the first detector and oscillator, with the two-gang tuning condenser

The detector (triode portion of the 1D8GT) is transformer-coupled to the power-amplifier pentode of the same tube, as shown at the right



I. F. transformer can with a screw driver, until the signal is at its loudest. Then tune to a weaker station (near 1,500 kc.) and give it a final adjustment.

The detector (triode portion of the 1D8GT) is transformer-coupled to the power-amplifier pentode of the 1D8GT. Unrectified RF currents in the plate circuit of the detector stage are by-passed to the chassis through a .002-mfd., 400-volt tubular condenser. Volume is controlled by means of the 500,000-ohm variable resistor across the secondary of the audio transformer. The S.P.S.T. on-and-off switch is also controlled by the shaft of the resistor.

Output of the two-tube super is fed into a 4" or 5" permanent-magnet speaker installed in the lid of the gray-wrinkle steel cabinet. A 3 $\frac{3}{4}$ " diameter opening must be drilled for the 4" speaker, and another opening about 4" in diameter in the front panel for the dial.

Loudspeaker reception of all local stations is possible, using an antenna of only about 20 feet, stretched across the room on the rug. No ground is necessary, although it may improve the volume on weak signals. A small trimmer condenser should be inserted in series with the antenna whenever a long antenna is used with the set.

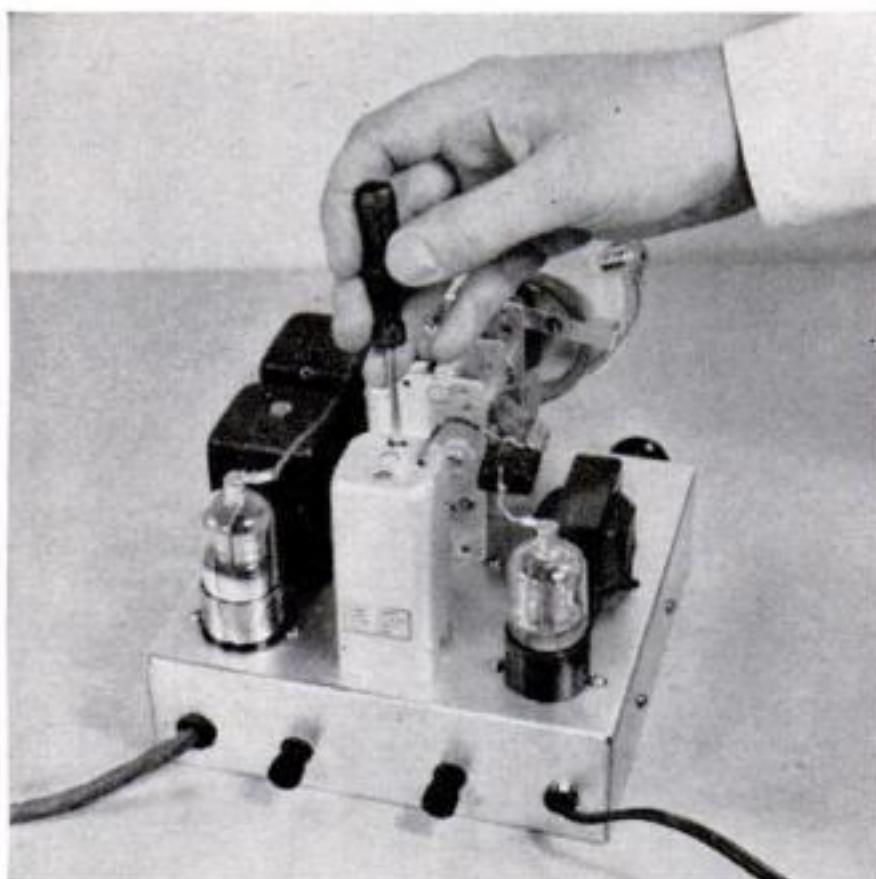
Although 90 volts is shown in the wiring diagram as the plate or "B" battery voltage this value may be safely increased to 110 or 120 volts with a correspondingly greater signal strength. In this case the "C" battery voltage should be advanced to 9 volts.

LIST OF PARTS

Steel chassis, 7" by 7" by 2".
 Shielded iron-core antenna coil.
 Shielded air-core oscillator coil.
 Two-gang tuning condenser, .00036 mfd.
 Four-inch round dial.
 I. F. transformer, 456 kc.
 Audio transformer, 3:1 ratio, unshielded.
 Output transformer, universal type.
 PM speaker, 4" or 5".
 Steel cabinet, 8" by 12" by 8".
 Volume control, 500,000 ohms.
 Switch cover plate, S. P. S. T.
 Variable trimmer condenser, .00005 mfd.
 Pentagrid converter tube, 1A7GT.
 Triode-pentode amplifier tube, 1D8GT.
 Octal (eight-prong) wafer sockets (two).
 Mica condensers: .0001 mfd., .00025 mfd., .004 mfd. (padder).
 Tubular condensers: 1 mfd., 400 volts; .05 mfd., 400 volts; .005 mfd., 400 volts; .002 mfd., 400 volts.
 Carbon resistors: $\frac{1}{2}$ watt, 50,000 ohms; $\frac{1}{2}$ watt, 70,000 ohms; $\frac{1}{2}$ watt, 2 megohms.
 Knobs, cable, binding posts, etc.

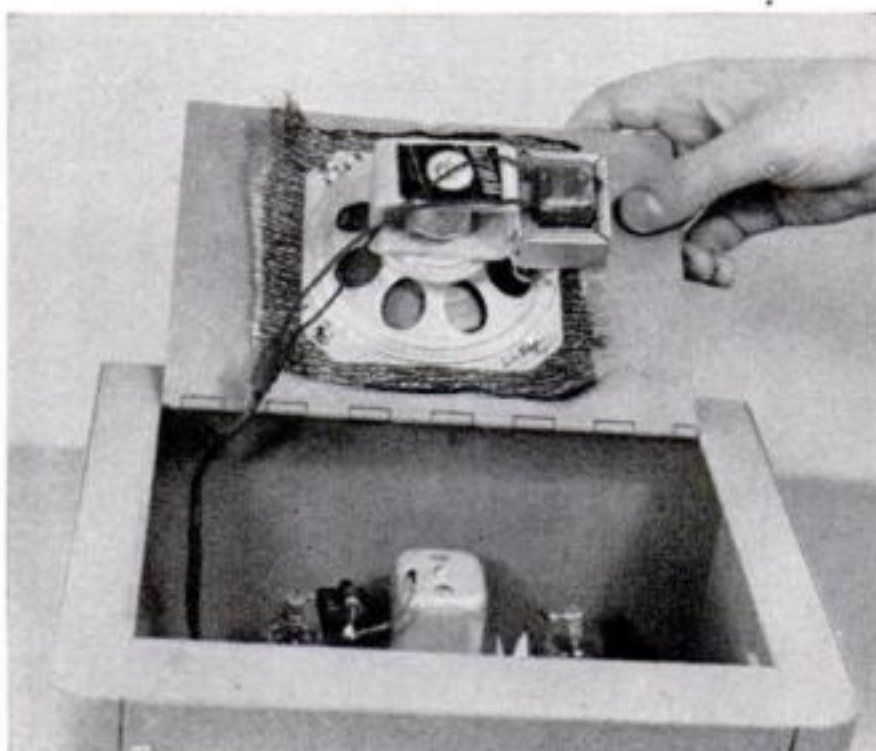


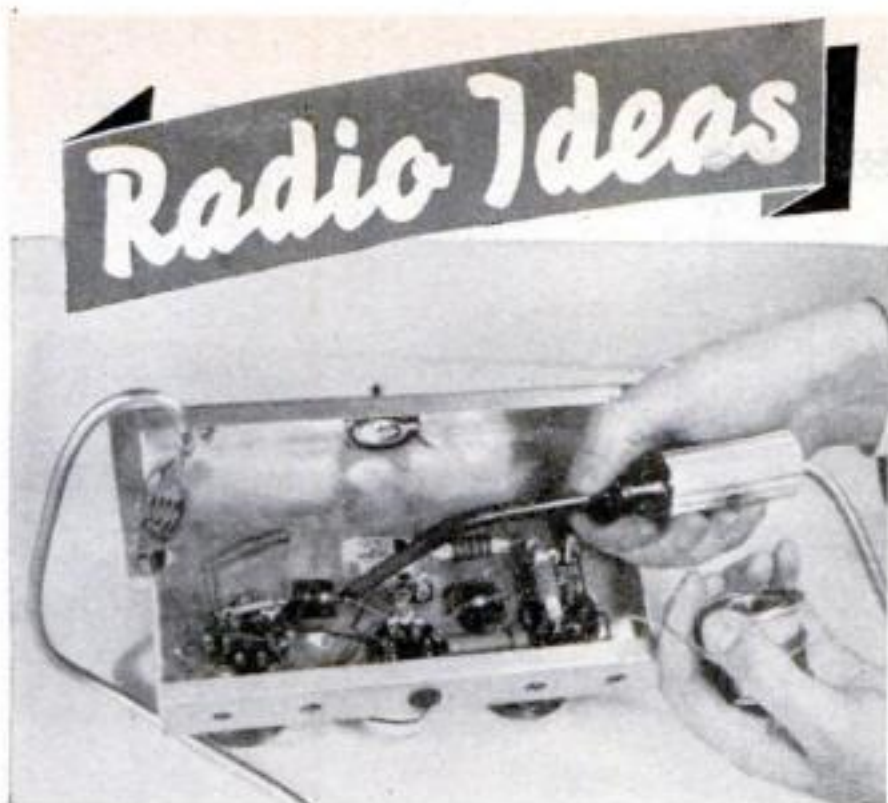
Front of the gray-wrinkle steel cabinet, showing the three control knobs and four-inch round dial



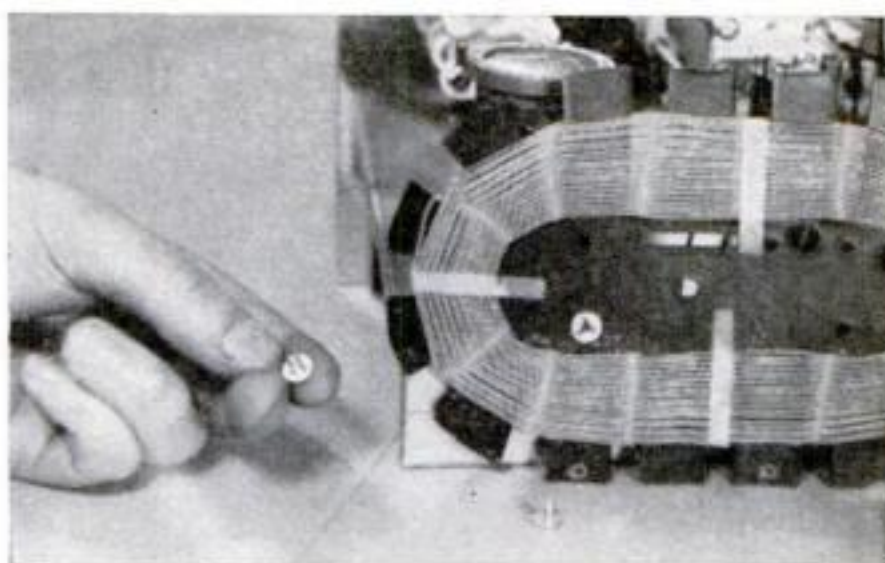
Both primary and secondary windings of the I.F. are tuned by turning the two screws on top of the transformer can until selected signals are loudest

Output is fed into a permanent-magnet loudspeaker (either four or five-inch) set in the cabinet lid

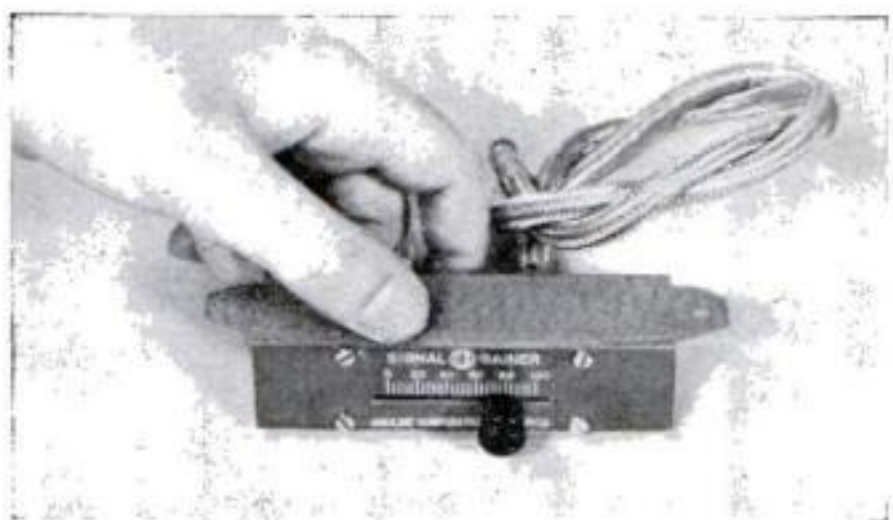




SOLDERING, WELDING OR BRAZING can be done practically anywhere with a new tool designed to operate on 6 or 12 volts, from storage or dry batteries. It draws only 15 amperes.



SNAP-IN FASTENERS for use in place of screws in many phases of radio construction work are on the market. They are available in four sizes, and are cadmium-plated to prevent rusting.



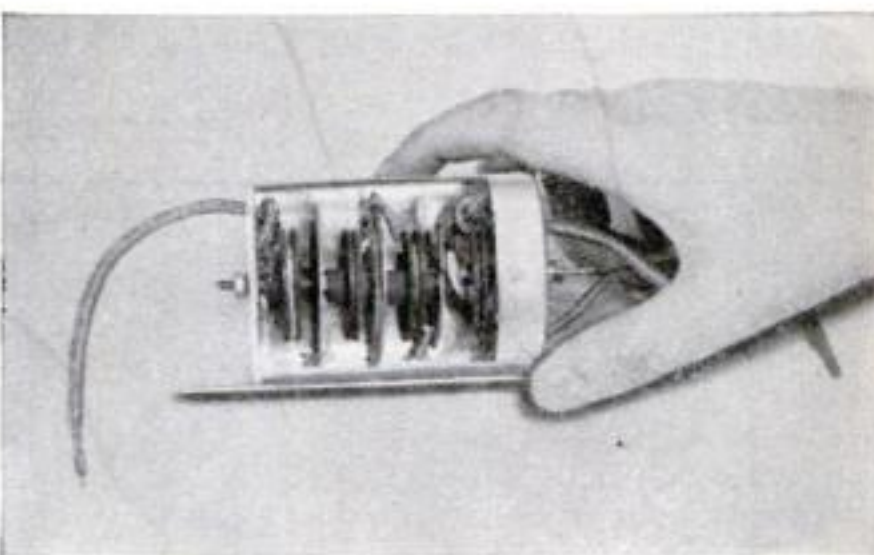
AUTOMOBILE RADIOS give better performance with this adjustable impedance unit which matches the car antenna to the antenna coil in the radio to provide the best signal-to-noise ratio. It can be installed without disturbing the radio.

RECORDING DISKS of paper and plastic are now available for home use. Being flexible, they will not crack or break easily, and they will retain good tone qualities under repeated play-backs.



CLEANING HOME RECORDINGS or commercial recordings with a new liquid leaves a plastic film on the disk, thus reducing surface noise and lengthening the life of the records in the same operation that cleans them. It is sold in two-ounce bottles.

ELIMINATING INTERFERENCE without affecting the efficient operation of the ignition system of a car is the object of the device shown below. It is installed in series with the car antenna.





Posing a model in a studio in the commercial department of a large photographic school. The resulting picture, intended for advertising purposes, appears at the right. Good as this work is, the average amateur could equal it if he would only follow the systematic methods used in the schools and master the fundamentals first



HOW TO Raise Yourself Out of the Snapshot Class

By ROBERT WOODMAN

EVERY photographic amateur wants to learn more about his hobby. One of the best ways to do this is to study photo technique step by step just as it is done in all good photographic schools.

Although they say that experience is the best teacher, the axiom is truer if you substitute "guided experience." In photography, for instance, when you make prints by contact or projection, you can use any one of a hundred different papers and have the choice of a score of developers, prepared or formulated. Obviously, you can't try them all, and to make a comparative evaluation would be a research problem in itself. So with other details, from selecting your subject to mounting the finished print.

That is why, at a certain stage in the

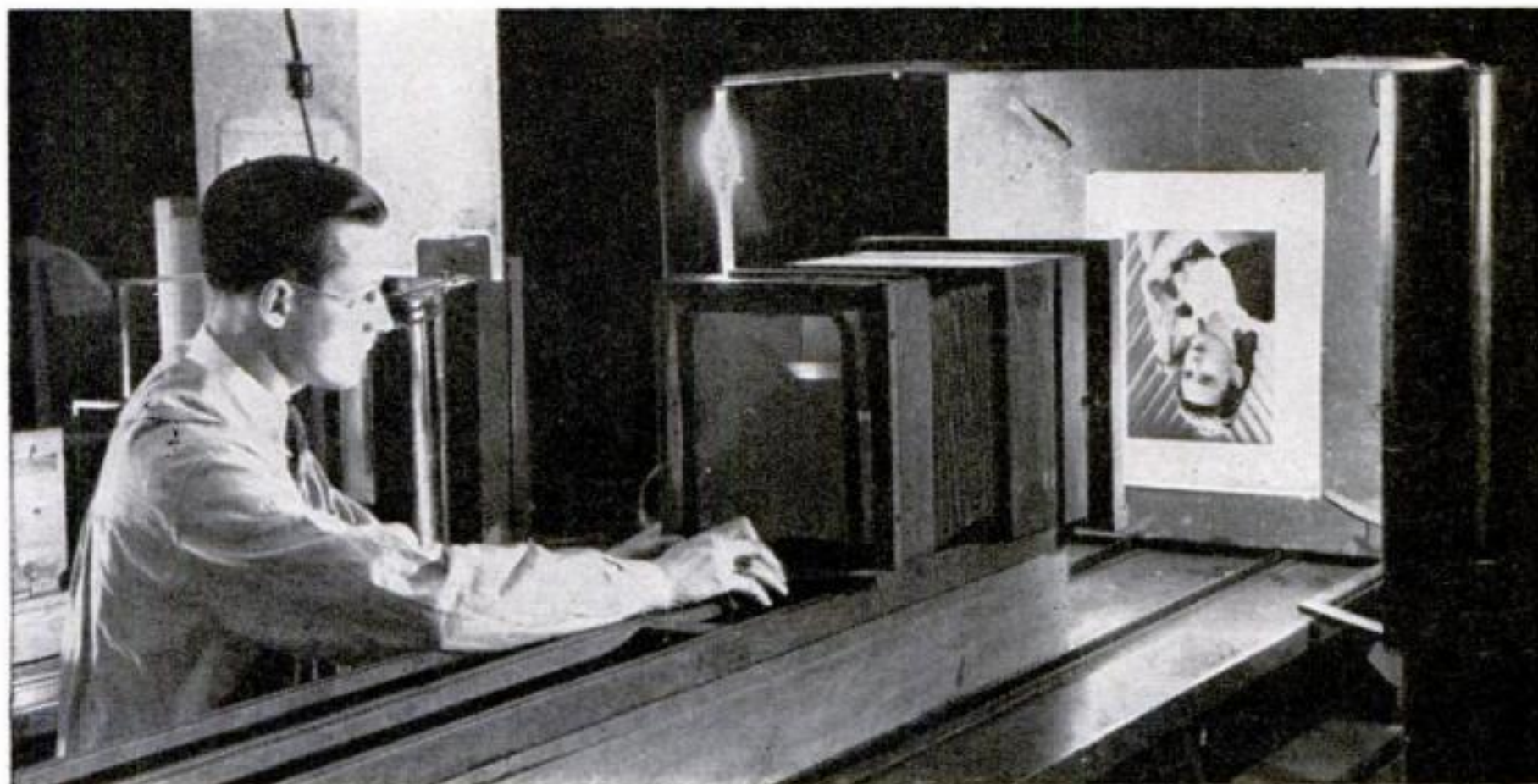
career of many an amateur photographer, a period of discouragement may set in. There's no real need for this. Photography is not so hard. Like any other craft, it's a question of doing the simple things first and building up to the more difficult ones later. Experience is easier to acquire if you begin with a good groundwork.

It is on this principle that every successful school of photography is run, and the amateur who wants to build up his knowledge without confusion would do well to follow the methods by which the students of such a school are led forward. This is by ascending from one level to the next only when a firm foundation has already been created for the take-off.

To attend the school itself would be the ideal method of applying this constructive discipline, but not every one of us has this opportunity. However, to impress ourselves with an object lesson for our own private guidance, let's pay a visit to a large school of photography and see if we can't garner a few principles for our own use.

For this purpose, our choice may well be the New York Institute of Photography, of New York City, one of the oldest and best known. It was in this particular school that the accompanying photos were taken. Because of its complete equipment and capable faculty, this school is well adapted to illustrate our purpose. There are other photographic schools, too, from which we can learn how to chart a clear course. We won't confine our discussion to one example, for the really basic methods are common to all good schools. *(Continued)*

First essential in photography: get a good negative. Just a simple task as the student below is learning, but an all-important one. In any school he must do it perfectly before he is allowed to advance. Here he is engaged in making a copy negative of another photograph . . . plain, flat lighting . . . no stunts





A homelike setting arranged to give practical experience in lighting and composition. Several studios at the New York Institute of Photography, for example, have settings that represent living rooms

An interesting and revealing characteristic of almost every school is its willing acceptance of intelligent beginners with no previous knowledge of photography. In fact, most will assert, in no uncertain terms, that their instructional material is absorbed from the outset with less effort, and with more completeness, by the sheer beginners. Those who may have acquired a superficial knowledge of some of the more advanced phases usually have to "unlearn" a great many things—and that's no fun!—in order to go back and master the fundamentals.

This holds a certain encouragement for the amateur who would build up his own experience in photography. It demonstrates that he can start off pretty well "from scratch" and, by applying the same kind of systematic methods as are used in the schools, advance himself almost to any point.

Most schools start the beginner with practical work, not lectures. The first step generally consists in making a plain photograph of some simple object, with plain lighting. Just the simple task of making a picture from an inanimate object. But a

good picture; that's the point. Before the student is allowed to progress beyond his first step, he must make the best possible picture under these primary conditions.

There's our key to good progress, if we only have will enough to apply it. Let's look back and survey our own first attempts in the hobby; they are probably typical.

Did we deliberately choose the simplest possible subject and then keep doggedly at it until we made a perfect photograph? Probably not. Instead, we tackled some such ambitious project as glamorizing the girl friend. No doubt we felt we didn't deserve the coolness which greeted our first prints of this subject, but after that we thought it might be better to essay something like a "salon" landscape. After reading of the effectiveness of a filter to bring out clouds or something, we bought one and tried it out. But maybe we had the wrong factor, or didn't use the right exposure, because again the result was disappointing.

After a few more haphazard tries with ambitious subjects, we fell back on the expedient of carrying our camera around with us all the time and snapping indiscriminate-

ly in the hope that, after all, *something* might turn out to be a good picture. But... did we ever say once, "I've floundered around long enough. Now I'll go right back to the beginning, set myself a photographic task and keep at it until I am thoroughly satisfied with results!"?

Yet, this is the way the schools begin, and it is the way they ultimately turn out graduates who make solid names in the profession. Of course, there is a friendly instructor always at your elbow to guide you, but the student has to do the work.

Good photographic quality in the rendition of a plain photographic subject should come first. Don't make any mistake about that. The New York Institute, for instance, lets the beginner make a simple copy negative—a photograph of a line drawing or of another print. Flat lighting... no stunts or poses... but excellent training. It concentrates attention on the primary care needed to make a good negative.

"But how about that friendly instructor at my elbow?" you will say.

True. That's why schools are better. But you can, if you wish, take a home-study or extension course, or you can follow these methods by yourself and, if you get stuck, refer to textbooks. The principal film manufacturers issue excellent manuals. Then, if you have will power enough to avoid the temptation of trying to imitate "glamour photographs" and trick manipulations, you'll find yourself doing nicely.

Even the owner of the simplest equipment can practice the step-by-step method to good advantage. As an example, select an

outdoor scene which has no deep shadows in combination with glaring, sunlit surfaces—a scene where the tonal values do not show great contrasts between light and dark. Such a scene is well within the "brightness range" that can be printed on normal photographic printing paper without special manipulation. Such a scene could be taken outdoors under a bright north sky, with no direct sunlight falling on the subject.

Perhaps this will come as a surprise. "What, no direct sunlight? I won't have enough light!" Never fear. You will already have lost your beginner's status when you discover that, with the fast films available, you can take excellent pictures without direct sunlight, even with a slower lens. Here we are avoiding direct sunlight because the surfaces on which it falls will be so much brighter in contrast with the shadows, and we are seeking evenness of tone as far as possible. And let's not include too much sky because so much more light comes from the sky than from foreground objects.

Again the precept of the photographic school: choose some inanimate object for the first attempt. A living subject is apt to distract the attention, become impatient, and the tendency is to get it over in a hurry. Inanimate subjects are not uninteresting; many salon successes show that. A well-made picture of the architecture of a doorway may prove really worth while for its rendition of textures and details.

But it isn't our purpose here to give specific instruction in photography. The first step has been outlined in some detail to show how experience can be made to serve its most use-

The temperature of the water may be kept constant with this automatic equipment found in the photo-chemical laboratories of an up-to-the-minute photographic school

Retouching is thoroughly taught. Here an instructor is showing a student how to retouch a negative on an illuminated desk





The exhibitions of students' work continuously held by the larger schools are well worth visiting. The print quality is invariably excellent, and this in itself is an indication that it pays to follow a thorough, well-planned course of study

ful purpose in following the simple, step-by-step method that is the basis of all formal instruction.

Having made sure that he has chosen a simple subject and has paid careful attention to the fundamentals, the amateur can then proceed to the operations which make these results visible—developing the negative and printing. There is apt to be less distraction in this, and it becomes easier to concentrate on what should become routine.

Luckily, system in developing is easy to apply, as the simple time-and-temperature method can be used with complete effectiveness. For this purpose, it is best to avoid the temptations offered for magic results by the use of the many mystic brews and pet formulas that come to one's attention. Standard, ready-mixed developers (powder or liquid) are available which, if used according to instructions, give dependable results.

The next step, as advanced in all schools, is to study the negative and, on the basis of this inspection, to decide which grade of printing paper can bring out its qualities best. The simple subject, already chosen,

should produce a negative which makes this inspection simple. Thus, the amateur can first familiarize himself with the operation of printing the image on a paper of normal contrast.

Paper developers are made up just as simply as negative developers. Patience, and a resolve not to attempt too much at once, will show the amateur how to print so that development takes place in the optimum time of a minute and a half or so. Shortstop and fixing baths are simple; so is washing, but these operations can't be hurried.

Don't be tempted to use all sorts of different materials if success is not immediate with one. Keep firmly to the mastery of one operation at a time. It pays.

Now, having learned how to follow through with a simple subject, you are in a position to return to the making of other pictures with more authority.

The school, of course, has equipment, studios, and darkrooms for the best application of these methods. For instance, the New York Institute has air-conditioned darkrooms, specially equipped for panchromatic negative development, print development, and contact printing and enlarging. It has nine studios where students may photograph anything from miniatures to

large groups of people. There are rows of illuminated retouching desks.

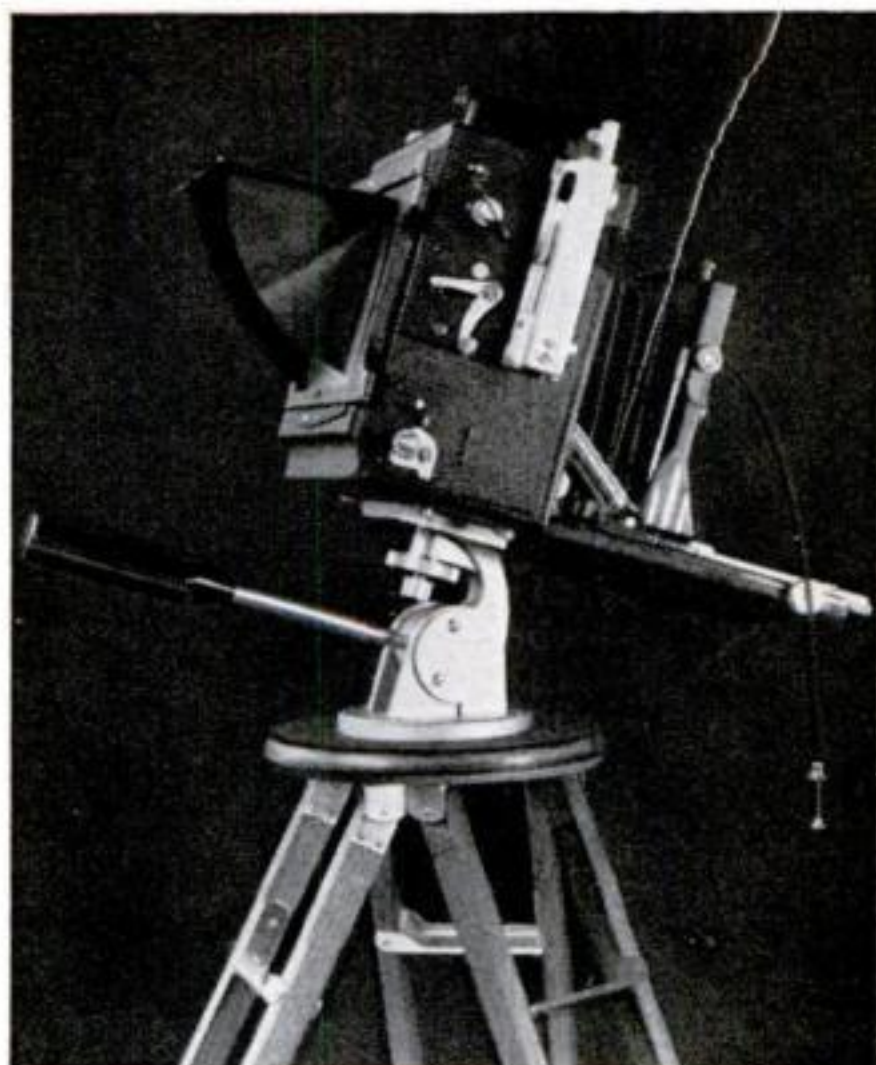
In this, as in others worthy of the name, there is always a current print show of students' best work, both in the graduate and undergraduate categories. These prints are a continuous indication of the school's effectiveness and are worth visits of inspection. The Rabinovitch and Clarence White schools in New York City, for example, also usually have interesting shows of this kind.

We have concerned ourselves with those operations which have to do with acquiring the fundamentals of photography. Naturally, schools go farther. We haven't gone into the details applied in many advanced steps, such as lighting, composition, portraiture, color-separation work, and the like. But we may be sure that a knowledge of all these advanced operations is gained by exactly the same step-by-step methods.

By all means visit a photographic school if you can. Even if you can't enroll, you can profit by the methods used and resolve to school yourself by mastering the fundamentals, one at a time.

FOR CAMERA USERS

A COMPACT PAN-TILT TRIPOD HEAD, which tilts 100 deg. forward or 250 deg. backward and rotates a full 360 deg., has been introduced for use with both still cameras and amateur movie cameras. The rotating and tilting movements are controlled and locked by a single handle, and the head is so designed that it may be half-locked with sufficient looseness to permit minor adjustments to be easily made.



CONTROL FOR FORTY FLASH BULBS. Uniform firing in synchronism either with a synchronizer or by open-and-shut flash is obtained with a multiflash control unit (left) that will accommodate from one to forty flash bulbs. It operates on house current or two 45-volt radio "B" batteries. A push button and rubber cord allow operation by remote control, and a neon tester (the neon bulb goes out if there is a break) permits a complete line and firing check at a glance. The unit is 7½" by 4½" by 4" and weighs 3½ lb.

ALL AUDIBLE TRACES OF "FLUTTER" in sound movies are said to be eliminated by a new device known as an "oscillatory stabilizer." Its purpose is to isolate the stop-and-go film movements from the sound drum so that no variations in film speed ever reach the scanning beam. As the film leaves the usual second sprocket, it passes through the stabilizer (indicated by the arrow) where remaining irregularities, no matter how minute, are reduced and then completely absorbed by an oscillatory movement operating on the principle that equal but opposing forces cancel each other. The reproduction of music and the spoken word thus reach the ear with uninterrupted fidelity.



TO ENLARGE the size of the field covered, the wide-angle lens attachment illustrated above can be screwed on top of a number of standard movie lenses. The focal length is changed from the usual 13 mm. to ¼", but the speed is unaffected, and movies may be taken under the same light conditions as previously. With this attachment it is possible to cover a much wider field of view, as is often desirable when taking interiors, theater stages, tall buildings, and the like.



Self-portraits can be taken with this new camera, so simple is its operation. A frame of the right size is attached, and notches on its rod make all the adjustments

Just below, front view of camera shows light reflector and opening through which picture is snapped. Below that, view from rear. At bottom, diagram of complete unit

Automatic Color Camera

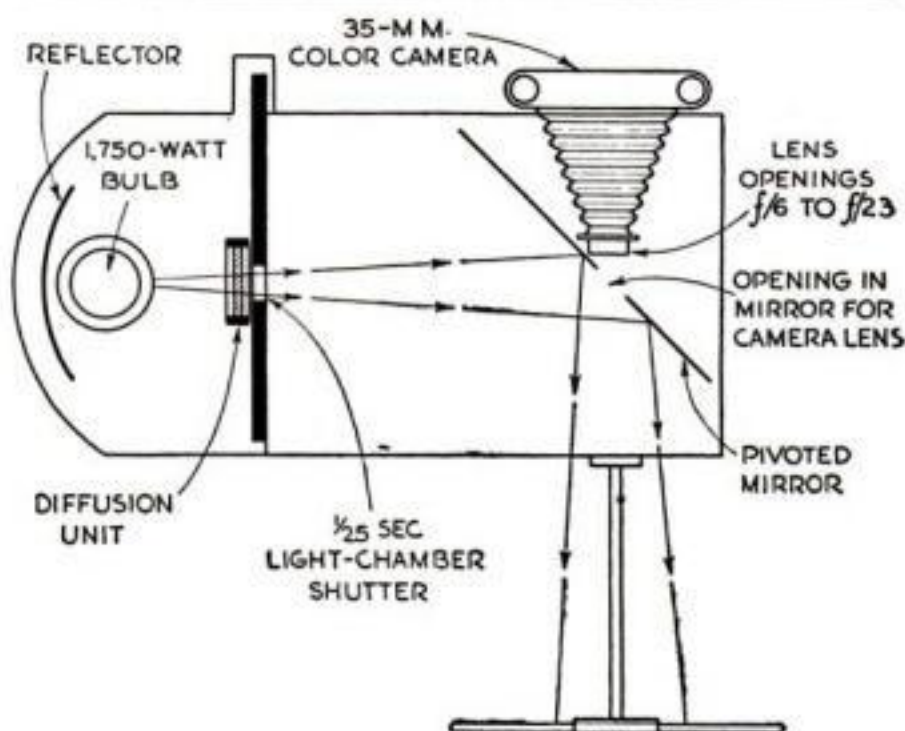
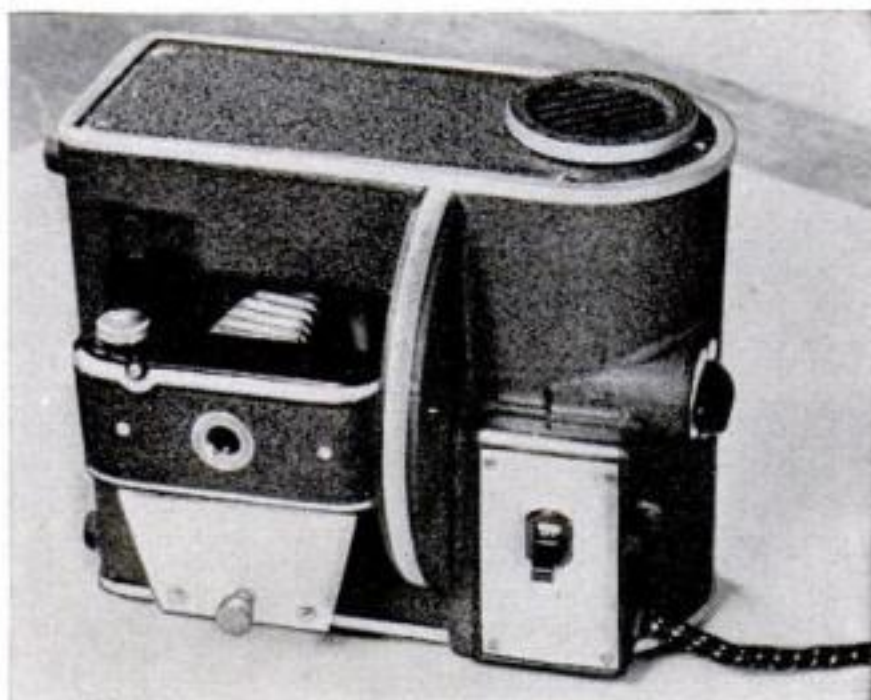
TAKING color photographs is an automatic and foolproof operation with a camera invented by Dr. Gustav Bucky, of New York, an X-ray expert and discoverer of the Grenz rays (X-rays of low penetrating power). Designed as a single unit, the camera is especially suitable for medical work because of its unique lighting system, which permits the illumination of cavities. It is equally efficient for other types of close-ups, and can be used for portraits or even full figures, such as fashion poses.

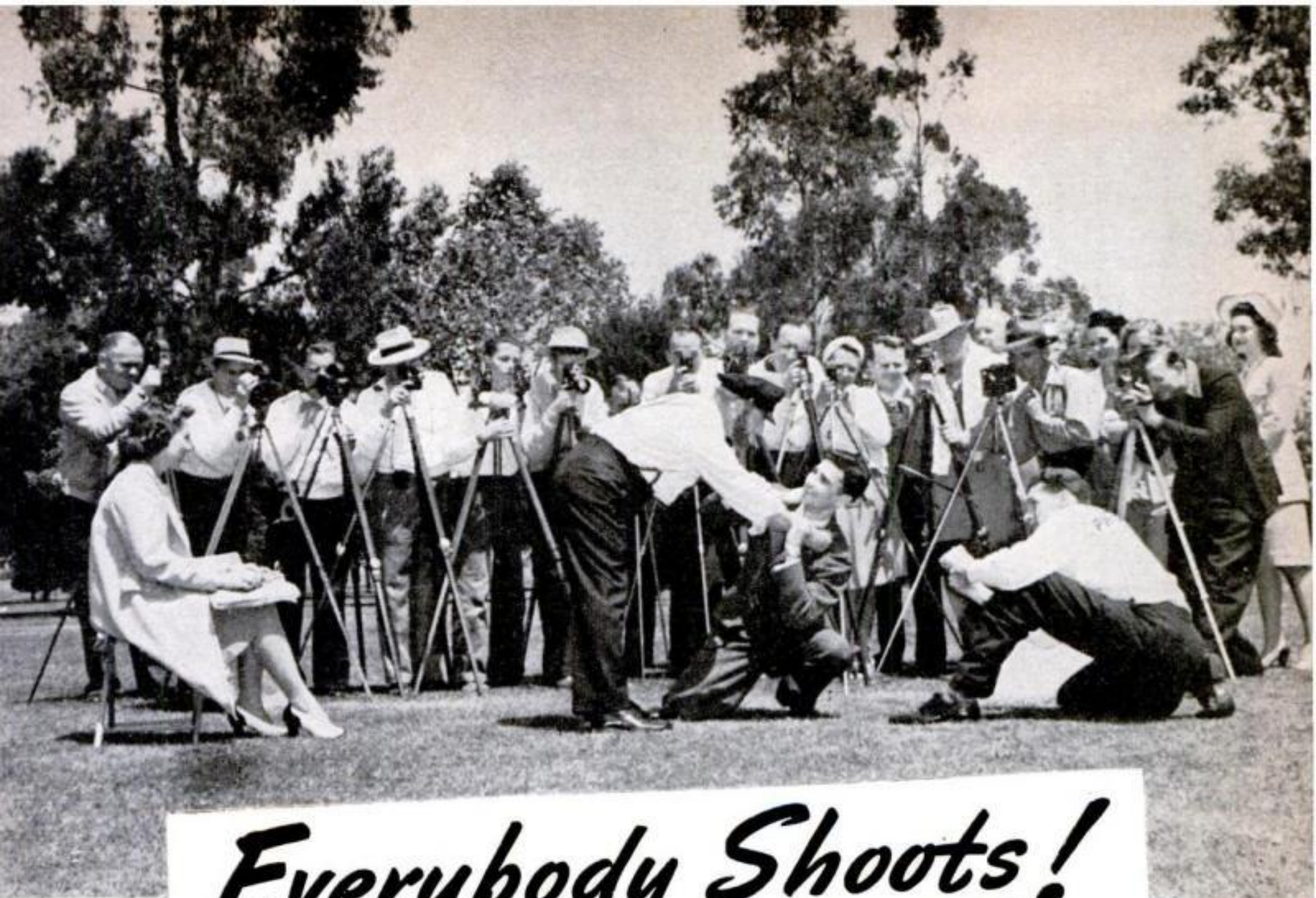
Focusing and shutter controls are automatically adjusted by attaching one of several frames to the camera. Each frame is a different size and is supported by a notched rod, which is inserted in the front of the camera and sets the adjustments.

The frame, when placed against the subject to be photographed, accomplishes five purposes: It establishes the distance between lens and subject; centers the subject; focuses the camera by adjusting the distance between film and lens; opens or closes the diaphragm to obtain the necessary depth of focus; and sets a mirror at the correct angle to reflect the light properly.

A special color-corrected projector type bulb of 1,750 watts, housed inside the unit, gives a 1/25-second flash through a separate shutter, which is tripped each time the regular shutter opens. The lamp turns on and off automatically, and is said to be good for 2,000 exposures.

Made of aluminum, the unit weighs 10 lb. It plugs into A.C. or D.C. of from 110 to 130 volts.—ARTHUR C. MILLER.





Everybody Shoots!

CINEMA CLUB POINTS WAY TO SUCCESSFUL MOVIE MAKING

By **ANDREW R. BOONE**

TO THE average amateur movie maker, shooting a dramatic continuity with real actors and actresses "on location" seems a rosy but impossible dream. For the fifty working members of the Long Beach, Calif., Cinema Club, it is very much a reality, and the magic word that has made it so is "coöperation."

By working together, these home-movie enthusiasts produce features running as long as 1,000' in 16-mm. film, obtain the use of special locations, the services of competent players, and have the advantage of technical planning and assistance. Yet, thanks to the method of working, individuality of expression is preserved, beginners are helped by the

more experienced, and all have an equal opportunity to do good work.

Club activities began modestly about three years ago when seven cameras filmed 23 scenes of a short one-reeler. There were four in the cast, including a dummy, and all the action took place around a park bench. Since then, the club has made six long features, besides a number of shorts. An 800' film, "Susanna," was so successful members voted for still longer pictures.

The latest of these, "Happy Landing," includes 97 scenes shot on seven locations, and is 1,000' long. Reflectors, make-up materials, and props were supplied by the club. Members started work at nine o'clock on eight successive Sundays. Those who had missed a day

TEN SHOOTING TIPS FROM THE LONG BEACH CINEMA CLUB

1. Long and semi-long shots should run 8 to 15 seconds. They help introduce the subject and definitely locate the action.
2. Medium shots should run 5 to 12 seconds, and include something besides the characters.
3. Moderate close-ups, showing characters full or three-quarter length, should run 5 to 8 seconds.
4. Close-ups should show the head, or head and shoulders, and run 2 to 5 seconds.
5. Study each scene through the finder. Avoid uninteresting foreground and blank sky.
6. Vary the shooting angles, but avoid exaggeration.
7. Never pan or tilt unless necessary. Make shots from different places rather than long pans or tilts.
8. Keep the camera and the water line in sea-scapes level. Don't shoot horizons at the center of pictures.
9. Hold the camera rock steady—on a tripod if possible.
10. Be sure before you shoot!

or spoiled a scene shot retakes on the ninth Sunday. Seventeen cameras filmed this picture, exposing more than 30,000' of film.

All the members are encouraged to work behind the camera, shooting and editing their own film versions of the story.

"We aim," explains President Mildred J. Caldwell, "to make good pictures, using all types of locations. Only by working together, with as many cameras as possible on the firing line, can we get enthusiasm within our own club and the coöperation of other individuals and organizations."

There is ample evidence that the club succeeds in its purpose. For one production, a chief of police furnished two motor patrolmen and closed a street to be used as a location. A telegraph company supplied two uniformed messengers with motor "scooters." On another occasion a hotel manager gave the club the exclusive use of a roof garden for interior shots and as a vantage point from which to take long shots of battleships at anchor. The management of a popular amusement pier closed it to the public while for five hours club members roamed about on it, getting shots of their romantic lead characters amid the barkers and colorful booths.

Besides cameramen, the club boasts amateur directors, actors, property men, and script writers. Club officers and technical advisers take pains to see that new members turn out satisfactory pictures. The club's success has established a definite trend toward longer films such as "Happy Landing."

As a first step in undertaking a new picture, prizes may be offered for stories. A script committee of five will select one of the entries and write the shooting script, of

which copies are supplied to all who wish to take part in the production. Word is sent to local "little theater" groups, to dancing schools and other sources of acting talent. Occasionally a want "ad" is run, calling for volunteer players.

Meanwhile a location manager scouts for likely spots, and a property man rounds up props. Candidates for the acting roles are interviewed and filmed with both 16- and 8-mm. cameras. These film tests are then viewed at a regular club meeting, and the cast is selected by popular vote.

The time for actual shooting now draws near. Clarence N. Aldrich, a Long Beach architect and officer of the club, plans the day's work for both the actors and the technical crew. He plots a schematic diagram showing the progressive action of each scene, the entrance, action, and exit of all characters, and camera angles.

Shortly after eight o'clock on the morning of the appointed day, the cast and Director Ray Fosholdt, who doubles as make-up artist, meet on location. For an hour Fosholdt works with pancake make-up and false whiskers, deftly putting his subjects "in character." By nine o'clock, the cameramen begin to arrive.

Each receives a number. When cramped for space, half the cameras shoot at one time, the scene being played twice. For long shots, cameramen stand in a line; for medium shots, they shift to a semicircle. Often as many as 23 cameras are trained on outdoor scenes. On extreme close-ups only two may be able to shoot from the desired angle, and the scene is reenacted ten times or more until all who wish have filmed it.

Individuals shoot much as they please. Member Harry Ward, Jr., for example, pre-



Shooting with two cameras on the same tripod. One has a $\frac{1}{2}$ " lens, the other 1", so that medium-long shots and close-ups can be taken simultaneously



Fitted to this cameraman's lens mount is a special fade attachment which will permit him, by merely pushing a plunger, to fade in or out on the scene

fers to use two cameras mounted on a single tripod. With a $\frac{1}{2}$ " lens in one and a 1" lens in the other, he photographs medium-long shots and close-ups simultaneously. Lynn Harshbarger fades scenes in and out with an attachment fitted to his lens mount. For close-ups, Harold O'Neal fits to his camera a long, light board with two wire frames. This gives him his focus and shows instantly just how much area the lens will cover at the predetermined distance. The same device is used for shooting titles by daylight.

Cameramen select the material for their own shots. One may omit a scene altogether, another subdue straight action in favor of comedy. Eventually each edits and cuts his own film, and adds his own titles. When all are ready, the pictures are shown at evening meetings, and special awards are given for the best ones.

"It is strange how many different versions result," comments Miss Caldwell. "No two members see the story from exactly the same viewpoint."

When not making a picture, the club meets twice monthly, once to review films made by members or by outsiders, and once for technical discussions. At the latter, the practical side of movie making is covered by qualified speakers, and often a member shows a picture that he has made alone and without help. This picture must proceed from a logical beginning to a satisfactory ending, and must be complete with titles. The producer is quizzed on his work, and if he makes an exceptionally high score, he

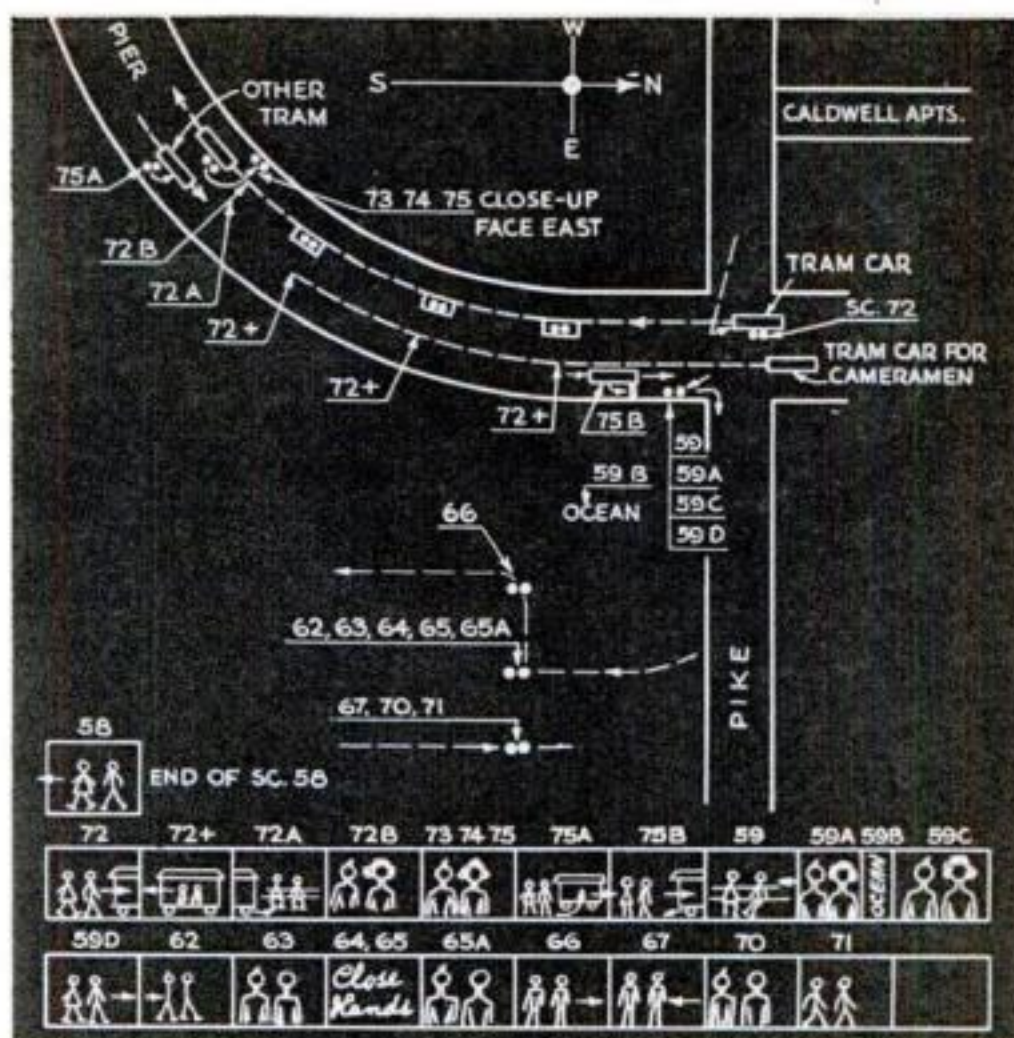
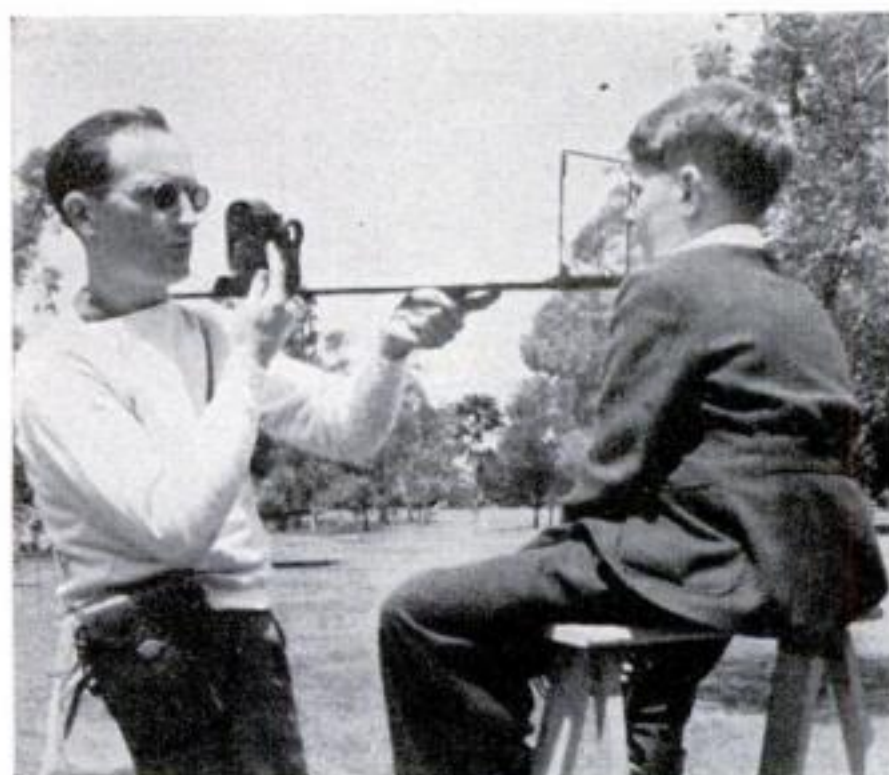


Diagram plotted in advance shows progressive action of scenes and camera angles. Each cameraman works with one

may become a technical advisor in the club.

"Knowing what your camera will do and how to use it," says Aldrich, who was the club's second president, "is more important than owning expensive equipment. A tripod is essential for steady screening. Consult your light meter before each shot."

Usually the conclusion of a picture is shot first, and the earlier scenes taken afterwards. "We're all anxious to see how the picture will end," explains LaNelle Fosholdt, one of the authors of "Happy Landing," "and by shooting in this way we get a better idea of filming the beginning."



This titling device—a wire frame on a wooden track—is also used when shifting rapidly from close-up to extreme close-up. Camera is hand held



Making up on location is begun an hour before the cameramen arrive. Here the director puts whiskers on an actor to get him in character for his part

Chipped Enamel Trays Repaired with New Plastic Resin Glue



NO MATTER how carefully they are handled, enamel photographic trays become chipped in time. It is important to touch up the damaged places promptly so as to protect the exposed metal and prevent contamination of developing solutions. An easy way to do this is to coat the spots with one of the new plastic resin glues. Mix the adhesive with water and apply it with the end of a pipe cleaner or a small brush. The cement sets in a few hours, is proof against chemicals, and seems to wear indefinitely.—K. M.

Cloth Strip Prevents Fogging of Film-Pack Negatives

FOGGING of parts of film-pack negatives can be eliminated by cutting a strip of black velvet or thin felt so that it will fit inside the back of the film-pack adapter and project for about $\frac{1}{2}$ ". Attach it with glue or cellulose cement. Each time a tab of the film pack is pulled out, press the edge of the black strip against the tab with the other hand. This will prevent fogging, even if the operation is done in bright light.—E. A. B.

A HAIR dryer is useful for blowing dust from cameras, film holders, and accessories. If the heating element is turned on, it can also be used to dry a damp camera.



Small Markers for Photo Slides Punched from Gummed Labels



A punch is used for making markers to be stuck on the slides

THUMB markers small enough to use on 2" by 2" projection slides are difficult to obtain, but excellent ones are easily cut from common gummed labels with the aid of a ten-cent paper punch. The markers are stuck in the upper right corner of the slides when in the proper position for projection. They may be numbered to keep a series of slides in correct sequence, and markers may be cut from variously colored labels to identify different sets of slides. When it is desired to turn out these markers in quantity, several sheets of the labels are stacked together so that they can be punched at one time.—C. E. B.

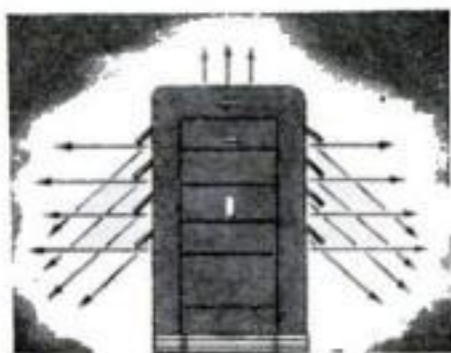
You can enjoy MODERN COMFORT IN YOUR STOVE-HEATED HOME!



Only SUPERFEX Oil Heaters give you modern triple-action heat..end old-fashioned ashes and drudgery!

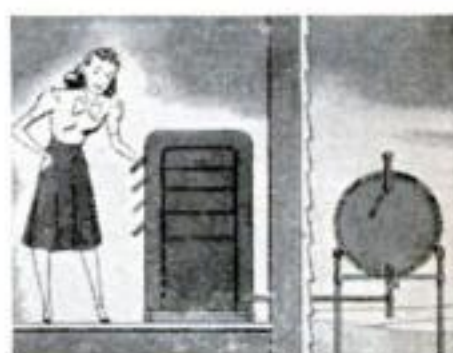
PATENTED SHUTTERS DIRECT RADIANT HEAT!

Superfex shutters *direct* cozy, sun-like radiant heat out and downward, warming the floor. And—Superfex circulates warm air throughout the rooms. No other heater gives you the triple comfort advantages of directed, radiant and circulated heat!



NO MORE ASHES, DIRT OR "COLD MORNINGS"!

If you wish, you can get Superfex Heaters that operate automatically...set thermostat for desired temperature—Superfex does the rest. No waiting for heat—no shaking a fire. Fuel is stored *outside*, piped in...no handling it! Economical, too—burns cheap, high-heat No. 2 fuel oil. Easy terms.



OTHER STYLES—Superfex and Ivanhoe models for every need, every budget. 3-speed blowers available on most models, where heating additional rooms is a difficult problem.

SUPERFEX and IVANHOE

OIL HEATERS

The Mark of Quality

PRODUCTS OF PERFECTION STOVE COMPANY



TRADE IN YOUR OLD STOVE • BALANCE EASY TERMS!

SEND FOR FREE, BEAUTIFULLY ILLUSTRATED BOOKLETS!

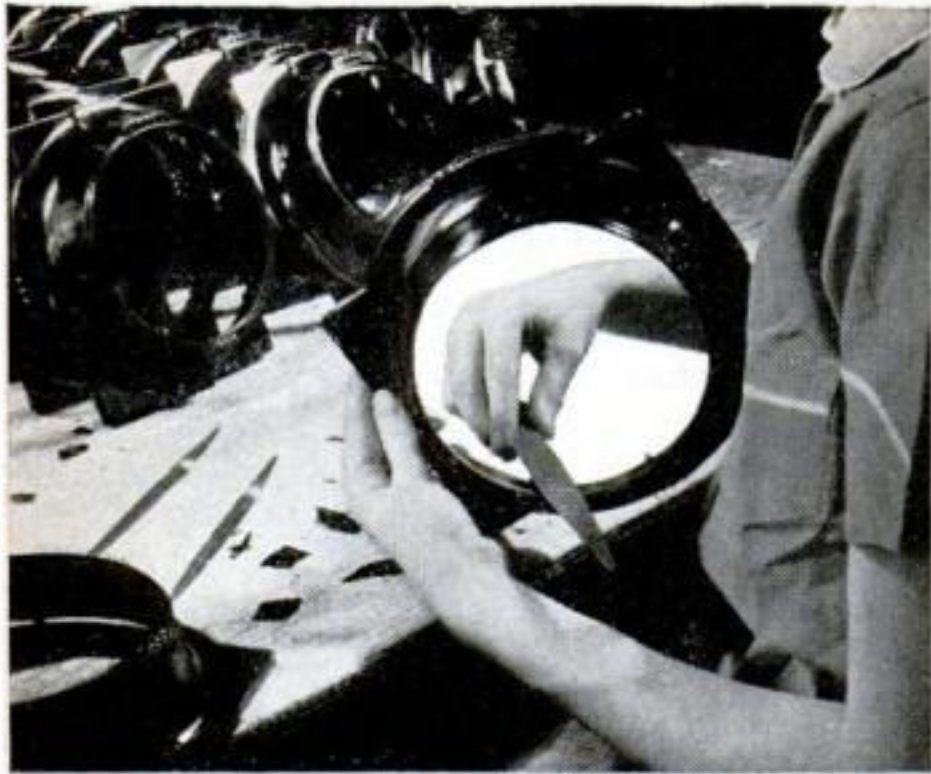
PERFECTION STOVE COMPANY
7323-A Platt Ave. • Cleveland, O.

Please send me the new, illustrated booklets describing the many models of Superfex and Ivanhoe Oil Heaters.

NAME _____

ADDRESS _____

POST OFFICE _____ STATE _____



Plastics get a speedy "manicure"

• The fast-growing plastics industry offers lucrative opportunities for the skilled worker—in shop, foundry and research laboratory. Files are an indispensable part of his tool kit. As with many other distinctive materials—like aluminum, stainless steel, for instance—working on plastics requires *The right file for the job.*

You can be sure you're right when you turn to Nicholson or Black Diamond brands. Nicholson—world's largest file manufacturer—keeps pace with every new development of industry involving filing problems, quickly designs the right file for best results and worker efficiency.

There are several thousand kinds, cuts and sizes of Nicholson and Black Diamond Files. But they all have one thing in common—and that's *quality!* Everywhere they're "making good"—and helping their users "make good." *Twelve perfect files in every dozen* is the guarantee of Nicholson and of the hardware or mill-supply house which sells them to you.



NICHOLSON
FILES FOR EVERY
PURPOSE

NICHOLSON
U.S.A.
MADE IN U. S. A.

FREE INFORMATION on plastics files.
FREE 28-PAGE ILLUSTRATED BOOK
"A File for Every Purpose."

NICHOLSON FILE CO., 19 Acorn St.
PROVIDENCE, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)



Gus Clears the Way

(Continued from page 136)

Bill still seemed doubtful. "Look at it this way," Gus said. "After a charge of gas and air has done its job of driving down a piston, the burned gases have to go somewhere, don't they? What I call exhaust service clears the way for those burned gases to get out into the open air—with the least possible resistance—where they can't do any harm."

"All right," Bill gave in, "you've converted me. But unless a muffler is so nearly clogged up that there isn't any exhaust coming through it, how can you tell whether there is anything wrong with the exhaust system?"

Gus got off the bench. "I'll show you how," he said. He walked over to a car and examined its muffler. "This looks O.K.," he said. "Now I'll show you how to find out whether it is O.K. Just raise the car about two feet on the hoist, will you?"

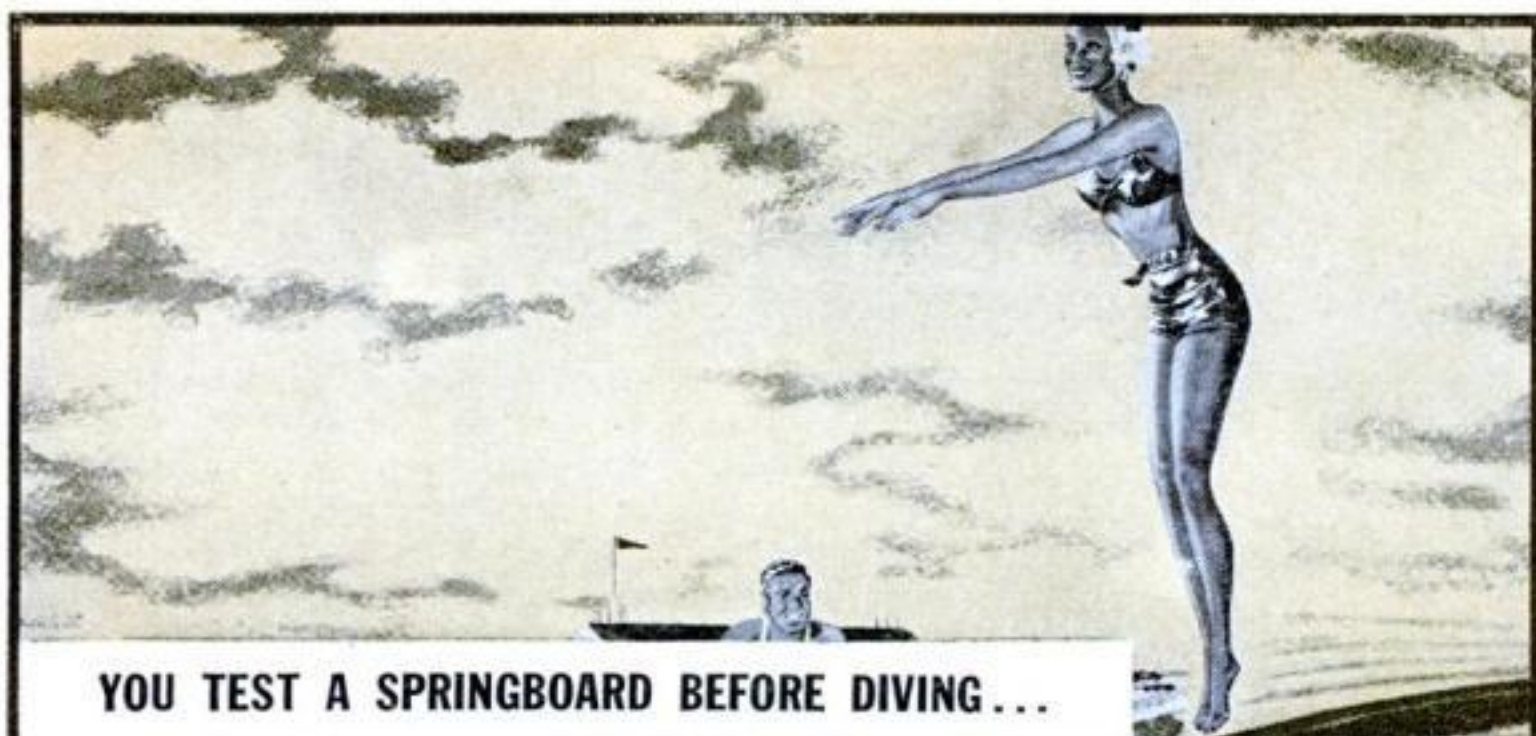
He went over to his workbench, and in a few minutes came back with a length of small rubber hose over his arm and a tapered wood plug in one hand and a can of light oil in the other. He tried the plug in the tail pipe and found that it fitted snugly. Then he showed Bill that it had a V-shaped cut a half inch deep extending its full depth. Going around to the front end of the car he disconnected the windshield wiper and then attached one end of a rubber tube to the intake manifold and dropped the other end in the can of oil.

"Start her up," he told Bill, "and then come down here with me."

Bill did as he was told. After a few seconds smoke began to float out from under the car's body. They got down on the floor to see where it was coming from. "It's the flange connection between the exhaust manifold and the exhaust pipe," Gus said. "Probably just needs tightening. . . That's a sure-fire check, Bill. If there is no smoke, the exhaust system is O.K. If there is smoke, you know that the part of the exhaust system it is coming from has gone bad."

"You've got something there," Bill said. "Say, maybe most of the cars that come in here should get that test."

"No 'maybe' about it," Gus told him. "I haven't any doubt that more than half of them need exhaust service. But I've never had much luck in convincing car owners that keeping the way clear for the exhaust to get out is important. Perhaps you'll have better luck. If you do, you'll save some of our customers both grief and money."



YOU TEST A SPRINGBOARD BEFORE DIVING...



SEE THE KARAT MARK ON GOLD BEFORE BUYING...



AND WHEN YOU STOP TO GET GASOLINE, THIS EMBLEM TELLS YOU WHICH PUMP CONTAINS THE BEST

THE BETTER THE GAS,
THE BETTER YOUR CAR

THE ETHYL EMBLEM on a gasoline pump stands for *extra* quality in anti-knock (octane number) and all-round value. Samples are double-checked by your oil company and the Ethyl laboratories.

In your car, "Ethyl" means a cooler-running engine in summer; a quicker-starting engine in winter; extra power and smoothness all year. When you stop for gasoline, the Ethyl emblem tells you which pump contains the best. ETHYL GASOLINE CORPORATION, NEW YORK

How Planes Fight at Night

(Continued from page 88)

diet which is particularly high in vitamin A and carotene content, then the men are given periodic injections of vitamins A and D. The next phase involves having the flyers and gunners spend periods of time in darkened rooms. During the time that they are on duty, waiting in their quarters to go aloft, the men wear dark-green goggles similar to those worn by welders, except that they have a tight-fitting rubber mask to cut off light from the sides or bottom.

When the signal for the take-off comes through from operations, their eyes are predisposed to the darkness outside. Within a moment or two, the airmen's vision thresholds are fully lowered, their night sight at its best. Deprived of this adjustment, they would dash out of a brightly lighted room onto the necessarily blacked-out field and would be able to see little if anything, unless the moon happened to be very bright. Even if they were able to take off safely, their night vision would not be at its best for approximately 30 minutes. This time element is vital, considering that the pilots can take off and climb to 10,000 feet in about ten minutes and, in all probability, make contact with the enemy within another five or ten minutes. The retina, which is equivalent to the film in a camera, does most of the adjusting, and this part of the eye is dotted with tiny receptors called "rods" and "cones." A quantity of pigment known as "visual purple" is present in the rods, and this may be compared to the emulsion on the camera film.

The first stage of adaptation requires about ten minutes, during which time cone threshold is lowering and you lose color perception. Then the rods take over, and during this second stage it takes them 20 minutes longer, just three times as long as the cones, to complete their function. Now objects appear a vague misty gray in color and indeterminate in size and shape; night vision is in effect.

Reproduction of the visual-purple substance on the retina has been found to be in direct proportion to the amount of Vitamin A in the system. This substance is essential to successful dark adaptation. Diet thus becomes of increasing importance in the conditioning of flying personnel.

Dr. Selig Hecht of Columbia University, Dr. H. De Silva of Yale, Col. A. D. Tuttle of United Airlines, and Dr. W. R. Miles of the National Research Council are working in close cooperation with the aviation medi-

(Continued on page 222)



TOUGH ON OIL-PUMPING GENTLE ON CYLINDER WALLS

● Oil-pumping is the red signal that warns "Your motor needs attention—don't delay." The longer you put it off—the more it costs. For oil-pumping usually means rapid cylinder wear has started—and that leads to a long trail of trouble and expense.

Play it safe. At the first sign of oil-pumping, get Hastings Steel-Vent Piston Rings. They stop oil-pumping and check costly cylinder wear. Any good mechanic can install them quickly and economically.

Buying a used car? Ask the dealer if it's Steel-Vent Reconditioned. It's a better buy if it is.

HASTINGS MANUFACTURING COMPANY • HASTINGS, MICHIGAN
Hastings Mfg. of Canada, Ltd., Toronto





...knows what's behind these Tools!

Every time a Delta worker pre-loads a ball bearing as shown in this photograph, he uses instruments so delicate that he can equalize variations in bearing "play" *too minute for human senses to detect!*

This man knows that the *unseen* precision which he puts into every Delta metal and wood-working machine—whether it's "pre-loading" ball bearings, "diamond boring", "precision grinding" or "dynamic balancing"—is but one reason for the amazing efficiency of Delta tools.

Another reason is the organization that stands behind every Delta worker. Delta engineers and technicians have pioneered practically every major improvement in this type of machine.

Today—as for the past 14 years—these unseen factors assure you that Delta gives you most machine value per dollar.

Send for Latest Delta Catalog

A complete guide book to power tools which not only lists the complete line of Delta "Quality" wood and metal working tools—but shows you the important points to look for in all power tools. It illustrates and explains the advantages of the many hidden features of design and construction that make for long, better service in power tools. (Also send for Project Book No. 8 crowded with new projects, including working drawings, photographs and full instructions.)



The Delta Manufacturing Co. (Dept. 683-L)
600-634 E. Vienna Avenue, Milwaukee

Gentlemen: Send me the latest Delta Catalog

listing the complete line of Delta Lathes, Circular Saws, Band Saws, Jointers, Scroll Saws, Shapers, Sanders and Drill Presses.

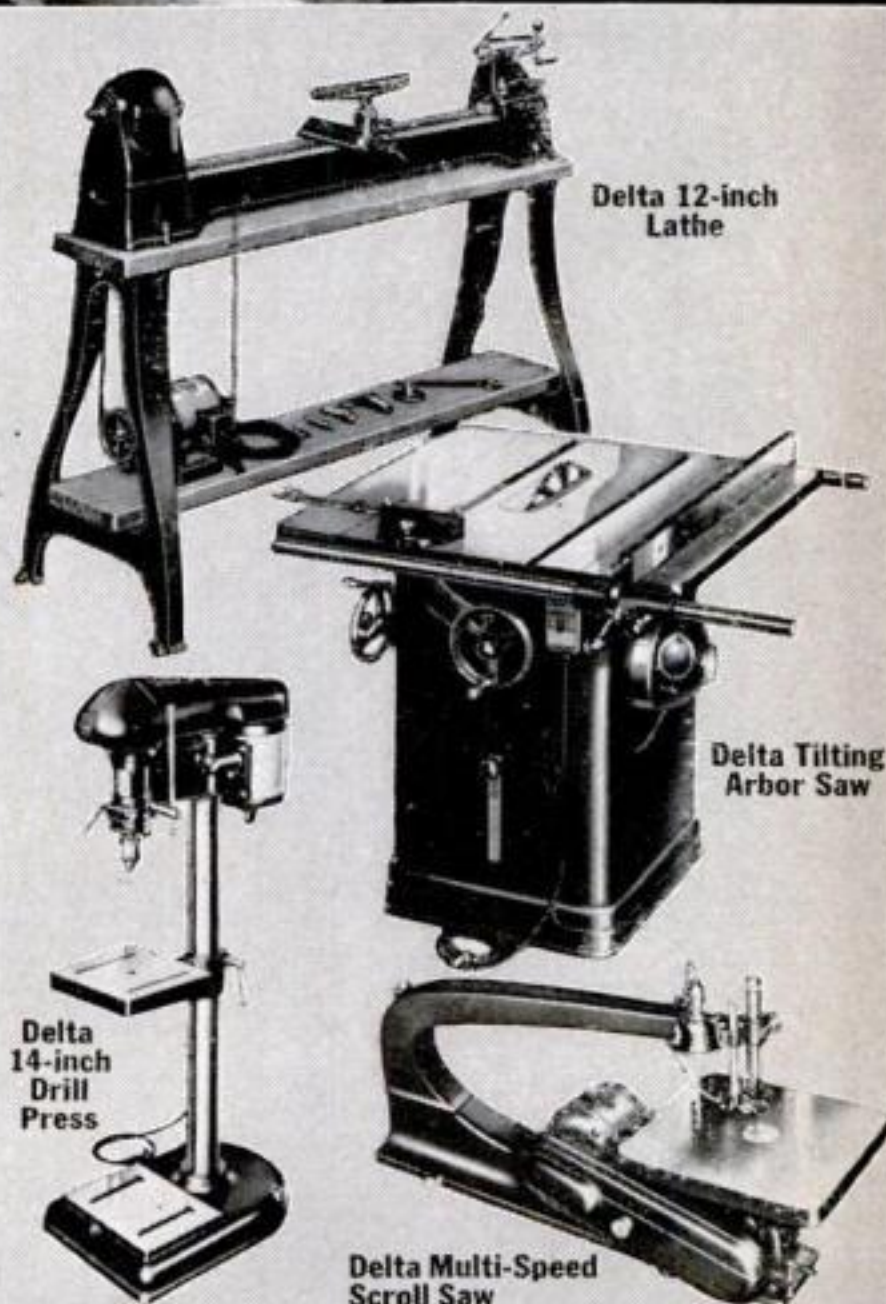
☐ I enclose 10c (stamps or coin) for which please send me the new Delta Project Book No. 8.

Name.....

Address.....

City.....State.....

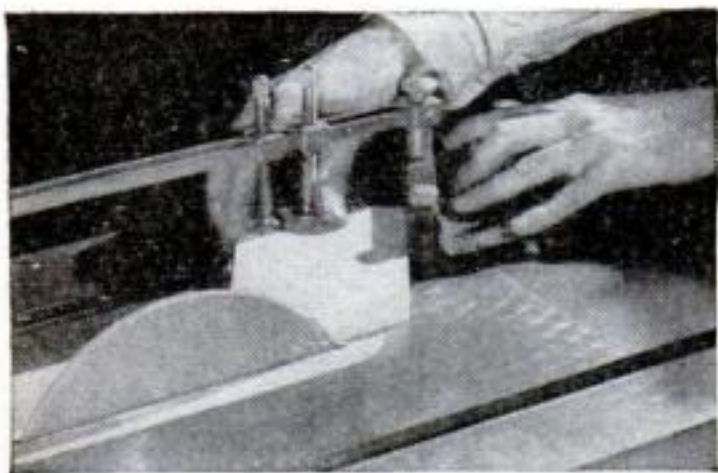
☐ Check here if you are a Delta user now.



DELTA

MILWAUKEE

How to sand a mitre cut on a circular saw!



● Take an old circular saw... grind off the teeth... cover one side with a coarse grit Aloxite Brand Aluminum Oxide Electrocoated "K5"-R Paper, the other with fine grit... and Presto! you have a highly efficient sanding machine. You can use this disc sander not only for sanding mitre cuts, but in dozens of other ways. And this disc is only one of the many Carborundum Brand Abrasive Products that can make your work easier and more pleasant.

High speed sanding in furniture factories



● Much of the sanding in woodworking plants is done with Aloxite Brand Aluminum Oxide Electrocoated "K5"-R Sanding Belts. These belts are famous for the way they speed up production, cut costs and produce finer finishes. They are the same quality products that are offered for use in your shop.

Send 10c for 95 page illustrated manual on home craftsmanship, and we'll include a souvenir sharpening stone.

CARBORUNDUM
ABRASIVE PRODUCTS

Write Dept. S-101

THE CARBORUNDUM COMPANY

REG. U. S. PAT. OFF.

Niagara Falls, N. Y.

(Carborundum, Aloxite and K5 are registered trade-marks of and indicate manufacture by The Carborundum Company)

How Planes Fight at Night

(Continued from page 220)

cine departments of our Air Corps and Naval Air Service on night-vision research.

Last, but far from least in this battle against the night bomber, is the problem of employing suitable types of aircraft for these "cat-eyed" men to fly. Generally speaking, the same characteristics are desirable in night craft that make for efficient daytime fighters and interceptors: speed, maneuverability, fast rate of climb, high ceiling, heavy fire power, ease of maintenance, and safe landing and take-off characteristics. Nighttime combat, however, is mostly a hit-and-run affair, and there is not so much close-in fighting and violent maneuvering as in daylight scraps. The main requisites are armament to shoot quickly, and in quantity, at the suddenly looming enemy, and good landing behavior.

Tactical use of these craft involves sending the long-range convoy-type fighters over enemy territory to carry out "watch-and-wait" strategy while holding the fast-climbing interceptor types for immediate engagements. The fighters hover over enemy air bases at high altitudes, then swoop down to nail the enemy bombers as they come home to roost. This is excellent strategy in that the bomber crews are pretty well unnerved, as well as being just about out of fuel and ammunition, after braving the interceptors and AA fire. It is natural for them to breathe a sigh of relief as their airdromes slide into view, and the psychological let-down comes when the long-range fighters appear out of nowhere.

Our newly formed Air Corps Interceptor Command is to be supplied with several modified types of planes for night operations. Long-range types could conceivably be the 458 m.p.h. Lockheed P-38E and the 420 m.p.h. Grumman P-50A. A sterling array of smaller pursuit-interceptors includes the Bell P-39C "Airacobra," Curtiss P-42 and P-46, Republic P-43 "Lancer," P-47B "Thunderbolt," and the North American P-51 "Apache." These ships are the finest of their types in the world, and we may rest assured that the American air chiefs know, perhaps better than any of their contemporaries on this troubled globe, the answer to the riddle of the night bomber.—JAMES L. H. PECK.

Question Bee Answers—Page 72

- | | | | | |
|------|------|------|------|-------|
| 1. b | 2. c | 3. c | 4. b | 5. c |
| 6. a | 7. b | 8. b | 9. a | 10. b |



Atlas

Swiftly and dependably, Atlas Lathes, Shapers, Drill Presses, Milling Machines, are setting new records for efficient production in the nation's armament program. The same Atlas qualities that are so helpful now to important defense industries, make Atlas machine tools increasingly valuable for all types of precision metal work.

ATLAS PRESS COMPANY KALAMAZOO, MICHIGAN




PHOTO ENLARGEMENTS

Is Photography your hobby? Do you want a profitable easy business at home? Make **PHOTO ENLARGEMENTS** for yourself and others. Your cost 5¢ each and less. The Ideal Photo Enlarger is **AUTOMATIC**. No experience required. Also **COPIES** any picture. \$5.94 **COMPLETE**. Interesting circular **FREE**.

IDEAL-X, 148 West 23 St., New York

5¢ ANY SIZE



AMAZING NEW ELECTRIC ARC WELDER

FULLY GUARANTEED

RETAILS ONLY \$2.95 COMPLETE

Plugs Into Light Socket

Amazing new **HANDI-WELD** Electric Arc Welder—operates from 110 volt, A.C., or D.C., same as other arc welders higher priced—generates tremendous heat to weld all kinds of metal. Not a toy welder that uses carbons, but actually uses standard coated rods—sizes 1/16" and 3/32". Generous supply furnished with welder. Guaranteed not to burn out. Repairs fenders, auto bodies, radiators, preheated small castings and machinery parts. Take **HANDI-WELD** anywhere to job, operate from light socket. Sturdily built of finest materials to last years. Fully guaranteed by Big Manufacturer. **SEND NO MONEY**—You'll find a thousand uses for the **HANDI-WELD** around your home, garage, work shop. Also by garages, factories, repair shops, farmers, inventors, tin shops, plumbers, etc. Order **HANDI-WELD** now. Send no money. We'll rush one to you, complete with rods and goggles. Pay postman only \$2.95 plus few cents postage. If not delighted, return **HANDI-WELD** in 5 days from receipt and money paid for it will be refunded instantly. Rush your order now.

KUMFY PRODUCTS INC., Dept. Y-205 Cincinnati, O.



Targo AERIAL SHOOTING

The game that everybody's shooting and talking about because it's aerial target practice at its best. Inexpensive, can be enjoyed in limited area. Targo Gun is .22 cal. smooth bore repeater (easily convertible to rifle). Trap can be used on gun, as shown, with shooter throwing his own targets, or on separate Hand Trap Frame.

Targo offers the fun of trapshooting and Skeet at moderate cost and trains the eye for any aerial shooting.

.22 Cal. 8-Shot Clip Repeater, Model 42TR. \$11.75*
 No. 1 Trap...\$6.45 Hand Trap Frame... .95
 Mossberg Targets slightly over 1/2¢ each
 *12.15 West of Rockies.

See Targo at your local dealer's, and send 3¢ for Targo folder.

O. F. MOSSBERG & SONS, Inc.
 9710 St. John Street, New Haven, Conn.

LEPAGE'S *IT'S NEW!* WATERPROOF *plastic resin* GLUE



Here's Proof that
it's absolutely
waterproof!

- QUICK MIXING
WITH COLD WATER
- READY-TO-USE
IN 30 SECONDS
- LASTING
STRENGTH

WE MADE THIS TEST
Two blocks of wood
were glued together with
LePage's Plastic Resin
Glue. Months later the
same two blocks were
still welded tightly—
proving conclusively
that LePage's is *absolutely*
waterproof.

Buy a can Today!

4 HANDY SIZES
10¢ 25¢ 50¢ 85¢



UNCLE NED SAYS:

YOU CAN MEND WALLS
IN A JIFFY WITH
**RUTLAND
PATCHING PLASTER**



Just mix with water
and apply with knife.
Rutland makes a patch
as lasting as the wall
itself.



Kit of Model Furniture for Colonial Bedroom

ALL the family will enjoy planning a Colonial bedroom around the authentic furniture offered in our Kit No. 15, priced at only one dollar. Cardboard walls of your own design, plus miniature crocheted rugs, curtains, a quilt and a bed canopy, will make the finished room a distinctive individual achievement. The kit includes the furniture shown, as well as the andirons, tongs, candle sconces, beakers, a jug, and a candlestick, all scaled one inch to the foot.

For a complete list of our kits, send a stamped, self-addressed envelope.

- | | | |
|------|---|--------|
| M. | Aircraft carrier SARATOGA, 18" long..... | \$1.00 |
| N. | Convoy of four U.S. destroyers, for aircraft carrier, each 6 1/4" long..... | .75 |
| U. | HISPANIOLA of the book and movie "Treasure Island," 7" long..... | .50 |
| 5S. | Coast Guard Patrol of 165 type, 20 3/8" long; scale, 1/8" equals 1'..... | 4.95* |
| 13S. | Motor Torpedo Boat P.T. 10; a 13" exhibition model (not a working model); shaped hull, propellers, ventilators, etc..... | 5.00† |
| 7. | Whittling kit with two shaped blocks for making sea captain 5 1/2" high..... | 1.50 |
| 8. | Whittling kit for six different Scotties; each is 2" by 2 1/4", sawed to shape..... | 1.00 |
| 13. | Miniature Early Colonial kitchen 21" long, 7" high, and 5" deep; walls, ceiling, and floor printed in four colors on heavy cardboard; with materials for furniture and finished fittings..... | 2.00 |

Note: If you live west of the Mississippi River add 50 cents to prices marked with an asterisk (*) and 25 cents to prices marked with a dagger (†).

Popular Science Monthly, Dept. 101A
353 Fourth Avenue, New York, N. Y.

Please send me Kit.....for which I
inclose \$.....(or send C.O.D. ☐)

Name

Address

City State

(Please print your name and address very clearly)

You save the C.O.D. charge by sending your remittance with this order. Remit by money order, check, or registered mail. This offer is made only in the United States. Also see note above.



Blueprints Improve Your Homecraft Products

VACATION days over, the craftsman will be eager to return to the workshop. Are you, perhaps, wondering what to make next? The following partial list of POPULAR SCIENCE blueprints may include just the thing you've had in mind all along, or it may offer several acceptable suggestions that have not yet occurred to you.

Planned construction is the key to successful homecraft projects. These tested plans leave nothing to chance. They are clear, accurate, reliable. If what you wish to make is not listed here, why not send a stamped, self-addressed envelope for a complete list of our blueprints?

MISCELLANEOUS

Aluminum Relish Dish, Turned Nautical Match Holder, Daylight Screen for Color Slides, 409A	\$.25
Bronze Hammer, Rolled-Edge Metal Tray, Table Centerpiece for Easter (rabbit hitched to wagon), 407A	.25
Five-Piece Desk Ensemble (letter rack, blotter, letter opener, etc.), Nautical Lamp (resembles engine-room telegraph), 410A	.25
Folding Wall Brackets (turned), Treble-Clef Bud Vase (metal or plastic), Vacuum Cleaner Attachment Rack, 408A	.25
Garden Trellises—Four trellises and one sundial post, 34	.25
Outdoorsman's Lightweight Trailer, 10' long, 4' wide, 4' 9" high, kitchenette on back, 300-301-R	.75
Turned Table Lamp, Deringer Pistol, and Weather Vane (woman watering garden), 406A	.25
Workbench for Home Shop, 24" by 58" by 34 1/4" high, 405	.25

BOATS

All-Purpose Boat, 11' 5" long, 331-R	.75
Cabin Cruiser, 17' long, weighs 750 lb., may be used with 2 to 10 h.p. outboard or inboard motors, 356-357-358-359-R	1.50
Cruising Sailboat, 19' long, weighs 700 lb., Marconi sloop rig; can be used with 1 to 4 h.p. motor, 400-401-402-403-404-R	2.00
Family Runabout, 13' 5 1/2" long, weighs 275 lb., for outboards from 1 to 60 h.p.; can also be rowed, 378-379-380-R	1.50
Fisherman's Outboard Boat, 9' 3" or 11' 6" long, weighs 115 or 160 lb., for motors from 3 to 16 h.p.; can also be rowed, 344-345-R	.75
Inboard Boat, 15' long, for motors from 1/2 to 5 h.p.; can also be rowed, 384-385-R	.75

(Continued on page 226)



MAKE AND MEND METAL PRODUCTS

Metalcraft is a hobby that pays dividends—not only in the attractive, useful things you can make, but in the vastly greater number of mending jobs you can do, once you've become acquainted with Kester Metal Mender.

Soldering is easy—with Kester Metal Mender. That's because the proper kind and amount of flux is contained right in the core of the solder itself. No messy separate fluxes to fool with; and the purity of Kester Metal Mender gives you perfect results every time.

You'll soon be making dozens of things from metals—objects that are more ornamental; and last longer, too. Lamps, ashtrays, wire baskets, kitchen gadgets, are only a few.

And Kester Metal Mender opens up an entirely new field for your "fixin' itch." Plumbing, auto and bicycle parts, household appliances, are easily mended with the help of Kester, and you save many a dollar.

If Kester Metal Mender isn't already in your tool kit, send the coupon today, for a generous get-acquainted sample, and booklet, "How to Use It."



Kester Solder Company, 4253-10 Wrightwood Ave., Chicago, Ill.
Please send me free sample of Kester Metal Mender and "How-to-Use-It" Booklet.

Name _____

Address _____

City _____ State _____

Mail the Coupon Now



P. W. RESETS LOOSE CASTERS

Repair loose casters on home and office furniture quickly and lastingly with PLASTIC WOOD! Fixes loose drawer pulls, bathroom tiles and fixtures, too. Get a can or tube today!



Handles like Putty
Hardens into Wood
SOLD AT HARDWARE, PAINT
AND 10¢ STORES

PLASTIC WOOD



Vacuum Cleaners, Electric Refrigerators and other household devices give longer, quieter service when lubricated regularly with Heavy Body 3-IN-ONE Oil. Get a can at Hardware, Drug, Grocery or 10¢ Store today!

HEAVY BODY 3-IN-ONE OIL

Plans for Tested Projects

(Continued from page 225)

Lapstreak Skiff, 13' 9" long, weighs 225 lb., for 1- to 16-h.p. outboard motors, 363-R.....	.50
Midget Boat or Pram, 9' long, weighs 75 lb., for oars, sail, or outboard motor, 339-R.....	.50
Motorboat-Rowboat, 13' long, decked hull, for use with outboard or inboard drives, 147-R.....	.50
Same, 14½' long, 148-R.....	.50
Same, 16' long, 149-R.....	.50
Plywood Dinghy, 9' 7" long, weighs 60 to 75 lb.; can be rowed, sailed, or used with small outboard motor, 387-388-R.....	.75
Racing Runabout, 13' stepless hydroplane for outboard motor, 261-262-R.....	.75
Racing Sailboat BLACKCAT, 13' 4" long, weighs 250 lb., Marconi rigged, 321-322-323-R.....	1.00
Runabout, 15' 6" long, weighs 550 lb., can be used with outboard or inboard motors of from 1 to 60 h.p., 175-176-177-R.....	1.00
Sailboat, 12' long, weighs 200 lb.; has fast skimming-dish hull, 314-R.....	.50
Sectional Rowboat, 9' 8" long, two sections, weighs 60 lb., all-wood construction; can be used with small outboard motor, 340-341-R....	.75

MODELS

Barnegat Lighthouse, 10½" high, 298A.....	.25
BLUENOSE, famous fishing schooner, 17½" hull, 110-111-112-R.....	1.00
Clipper Ship GREAT REPUBLIC, 31½" hull, 272-273-274-R.....	1.25
Clipper Ship SEA WITCH, 9½" hull, 219.....	.25
Concord Stagecoach DIAMOND TALLY-HO, 20½" long, 115-116-117-R.....	1.00
Confederate Raider ALABAMA, 21½" hull, 335-336-337-R.....	1.50
Elizabethan Galleon REVENGE, 21" hull, 206-207-208-209.....	1.00
Liner QUEEN MARY, 10¼" hull, 283.....	.25
Miniature Fleet of Nine Modern U. S. Fighting Ships (full-size plans and instructions in booklet form), 372-R.....	.50
NOURMAHAL, power yacht, 8¼" hull, 276.....	.25
Ocean Freighter, 14" hull, 271.....	.25
U. S. Battleship TEXAS, 3' hull, 197-198-199-200.....	1.00

FURNITURE

Bookcase for Holding Copies of Popular Science Monthly, 353A.....	.25
Double-Decker Bed, 277A.....	.25
Drafting Table, 189A.....	.25
Early American Round-Top Stand, 191A.....	.50
Floor Lamp, with tripod base, 243A.....	.25
Four-Leaf Card or Occasional Table, 239A.....	.25
Hanging Wall Cabinet, 9½" by 24" by 41¼", and Nautical Porch Lamp, 280A.....	.25
Silverware Chest on Stand, 256A.....	.25
Small Early Colonial Pine Chest, 32" long, 21" deep, 24" high, 308A.....	.25
Tile-Top Tables (wood and metal), 249A.....	.25
Upholstered Stool, 240A.....	.25

LEAFLETS AND BOOKLETS

Garden Fireplaces, Furniture, and Pools.....	.35
Hints on Cutting and Drilling Glass.....	.15
How to Build and Operate an Inexpensive Arc Welder and Spot Welder.....	.50
How to Make Your Own Marionettes.....	.50
Workbenches and Tool Cabinets (leaflet).....	.10

Popular Science Monthly

353 Fourth Avenue, New York, N. Y.

Send me the blueprint, or blueprints, numbered as follows:

I am inclosing.....dollars.....cents

Name

Street

City and State

(Please print your name and address very clearly.)

GENUINE *SpeedWay* **ELECTRIC TOOLS**

Backed by 30 years of electric tool leadership. Correct designs and speeds... specially wound high torque 110V universal SpeedWay Tool Motors. 1000 RPM Drill has pistol grip, die cast case and $\frac{3}{8}$ " capacity in steel. 20,000 RPM Hand Grinder has $\frac{1}{4}$ " and $\frac{3}{8}$ " collets. Sold individually or in Steel Kit with 5 accessories. Stand takes Drill or Grinder. Frame converts Grinder into Router. Bench Grinder is complete with motor and 2 wheels. All cords waterproof with unbreakable plugs.

DRILL \$995 **GRINDER \$95** **KIT \$1795**

DRILL STAND \$445 **BENCH GRINDER \$985**

SPEEDWAY MFG. CO.
1824 S. 52nd Ave., Cicero, Ill.

RELAX and RIDE

No need to worry about directions. Get—
The Hull Streamline Auto Compass
Built-in Compensator
Only \$2.95 at Your Dealer
Write for Literature

HULL MFG. CO., P.O. Box 246-E10, Warren, Ohio

WITTE DIESELECTRIC PLANTS

Your present power bill will buy a WITTE that produces power and light for 1c a K.W.H. Save up to 75%. A Size for Every Need. Write today for finance plan, literature and name of dealer.

WITTE ENGINE WORKS, 2227 OAKLAND AVE., KANSAS CITY, MO.

New ELECTRIC SANDER SAVES TIME

New Electric GUILDSANDER saves hours of time and labor. Gives factory finish on every job. Works on many different materials and shapes. Light, portable. Works from any light socket. Popular price. See your dealer or write for FREE illustrated folder.

SYRACUSE GUILD TOOL CO., 1741-108 No. Salina St., Syracuse, N. Y.

FREE CHEMISTRY BOOK

Big valuable laboratory catalog easily worth 25c—FREE—listing thousands of C. P. chemicals, apparatus, microscopes, scientific books, biological and laboratory supplies. Items as low as 5c. Equipment for complete industrial, professional and home laboratories at bargain prices. Save money! Get your copy of handbook NOW! Send 3c postage for this free catalog.

KEMKIT SCIENTIFIC CORP.
397A Bridge St. Brooklyn, New York

Try **GLOVER'S** at our Expense

DON WOODS, appearing in "BACHELOR DADDY," a Columbia picture, uses GLOVER'S!

Men, you can take a tip from the stars—if you've been using *scented* hair preparations without success, switch to the **MEDICINAL** treatment used by millions! Try GLOVER'S with massage, at our expense—for Dandruff, Itchy Scalp and excessive Falling Hair! You'll actually feel the exhilarating effect *instantly*!

Do this today—get a regular size bottle of famous GLOVER'S MANGE MEDICINE at any Drug Store—apply as directed—and you'll be agreeably surprised by the results! Be sure to use the NEW GLOVER Shampoo or Glover's Medicated Soap for shampoo. Notice how clean and manageable it leaves your hair! And remember—if not fully satisfied, mail bottle to us, and your money will be promptly refunded!

FREE sample of Glover's and booklet on Scientific Care of Scalp and Hair, on request. Send name, address and 3¢ to cover postage today!

GLOVER'S, Dept. 4110, 460 Fourth Avenue, New York

GLOVER'S
For DANDRUFF & ITCHY SCALP

"Make \$150 to \$300 Monthly with 'Simplified' Arc Welding"

With this Hobart generator, a used auto engine and chassis, you can build your own portable gas drive arc welder at a savings of from \$300 to \$500 over complete factory built equipment. With this welder you can go anywhere to get the profitable emergency repair and construction jobs.

TRY IT ON YOUR WORK

"BUILD-YOUR-OWN" GENERATOR

It's easy to get the big pay jobs that bring in real profit! Hobart Arc Welders are simple to operate, weld faster and guarantee better quality welds. Pay for your welder in a short time out of extra profits. Write for details.

FREE! This valuable book telling all about new profitable welding applications. Write today!

Hobart Bros. Co., Box P-101, Troy, Ohio

THE SHOOTER'S BIBLE
1942 EDITION
512 PAGES
\$1

STOEGER ARMS CORPORATION

NOW READY for the GUNSMITH SHOOTER and HOBBYIST

STOEGER 1942 World's Greatest Gun & Gunsmith Guide

512 PAGES—16,000 ITEMS—6,000 PICTURES (hundreds in color). Contains the only complete Gun Tool Section for amateur and professional. Finest Hand Tools. All American Guns, Shotguns, Rifles, Revolvers, Pistols, Airguns. 100 PAGES GUN PARTS (illustrated). Restocking, Remodeling, Reloading; Walnut Stocks and Blanks; Ballistics, Barrels, Targets, Scopes; Thousands of Accessories. Latest prices and specifications. Send a DOLLAR BILL, check, money order or stamps for the new 1942 "Shooters Bible."

FILL OUT AND ATTACH A DOLLAR BILL

STOEGER ARMS CORP., 507 FIFTH AVE. (at 42nd St.) NEW YORK

NAME
ADDRESS
CITY STATE P.S.

60 Prize-winning PHOTOGRAPHS

and how they were made
[Full Technical Data]

only
10¢

Edited by Willard D. Morgan

Co-Author: The Leica Manual, Miniature Camera Work.

This beautiful 64 page booklet brings you the cream of the winners in recent contests and exhibits! Subjects include animals, birds, children, babies, nudes, industrial, landscape, still life, and action-news shots. Every one a prize-winner in its class! Beautiful reproduction prints, with captions giving complete data on camera, lens, filter, film, lighting conditions, exposure, development, etc. In addition, Editor Morgan analyzes each print for its prize-winning qualities, and gives you five essential rules to follow for success in taking and submitting photos in prize contests. This booklet is a gold mine of interest and help for every photographer. Mail coupon now with dime to National Educational Alliance, Inc., Dept. 8010A, 37 W. 47th St., New York.

National Educational Alliance, Inc.,
Dept. 8010A, 37 West 47th St., New York

Yes, I want "60 Prize-Winning Photographs, and How They Were Made". I enclose a dime.

Name.....

Address.....

Write FOR MY NEW Still Bargainingram No. 250 ... it's Free!

... Lists Thousands of NEW and USED STILL CAMERAS and ACCESSORIES. Also CINE Catalog No. 245. Write Dept. PS

Bass CAMERA CO.
179 W. MADISON ST., CHICAGO, ILL.

OWN A Printing Business

Cards, Tickets, Stationery, etc. Good profit in spare time. PRINT YOUR OWN greeting cards, movie titles, church work, etc. Save money. Easy rules supplied. Junior Press \$8, Senior Outfits \$16 up. Have home shop. Raised printing like engraving too. Sold direct from factory only. Write for free catalog and all details. **KELSEY, INC. X-33, MERIDEN, CONN.**

Makes marvelous movies at everybody's price
CINÉ-KODAK EIGHT

See it at your dealer's

COLOR!

Pictures in Gorgeous Kodachrome are easy to make with ALL ARGUS CAMERAS

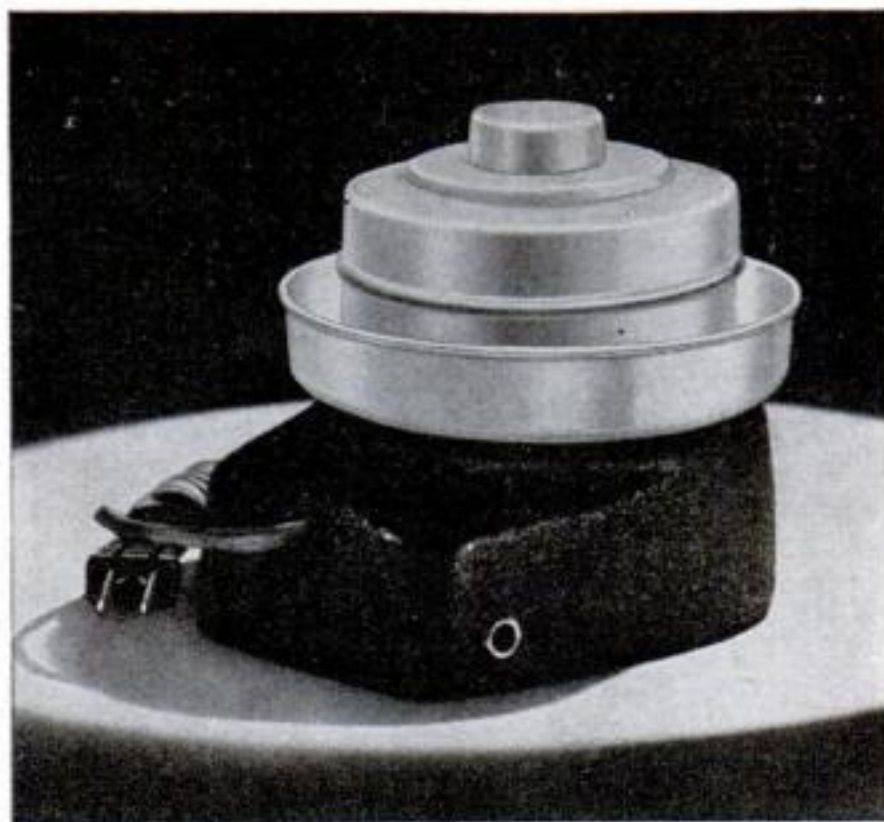
KODACHROME

MODEL A3 with extinction type exposure meter ... 1650

FREE "CHOOSING YOUR CAMERA"
Write for this 32 page booklet

argus
ann arbor michigan

Fine American Made Cameras

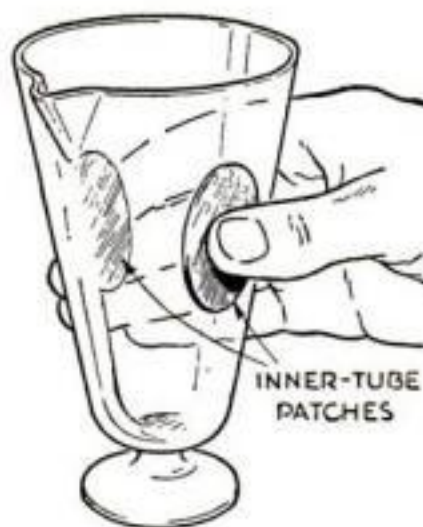


Low-Priced Electric Agitator Keeps Film Tank in Motion

ADEQUATE agitation is important in developing films, but difficult to obtain except with expensive apparatus. This relatively, low-priced electric agitator, however, is said to give the desired intermittent motion to any developing tank of 2 qt. capacity or less. The motion, being nondirectional and parallel to the plane of rotation, changes the circulation every 1½ seconds and brings fresh developer in contact with the film.

Rubber Patches on Graduate Provide Nonslip Grip

TO INSURE against accidentally dropping a glass graduate when your fingers are wet or greasy, attach two small rubber inner tube patches to the glass with cement. These grips also provide finger protection when hot fluids are being mixed.



Cutting and Folding Cardboard

TO MAKE a shipping carton smaller or cut heavy cardboard, try using a knife with a serrated edge. If cardboard is to be given a sharp bend, it should first be scored on a straight line inside the bend with a blunt object such as a knife handle. For thick material, two scores about ⅛" apart are required.—H. N. TOFTOY.

Please mention POPULAR SCIENCE when writing to advertisers.



Infra-Red Flash Bulbs Take Blackout Photographs

THE growing interest among photographers in taking so-called "blackout" photos (see P.S.M., Sept. '41, p. 208) has resulted in the development of a special flash bulb designed for the purpose. It is a hydronalium wire-filled flash bulb coated with a black infra-red filter. This coating serves to hold back the visible light produced by the flash, but transmits the infra-red rays. It is necessary, of course, to use infra-red sensitive film in the camera. Special reflectors may be had, but are not essential.



Dancers relaxing in darkened stage wings. One blackout lamp 12' from camera; 1/50 sec., f/4.5



Give your own homecraft projects and models the same consideration the aircraft engineers give their products. Use **WELDWOOD GLUE**—the glue of the aircraft industry—proven by tests to surpass any other plastic resin adhesive. (\$1000 challenge to anyone disproving these basic tests went unclaimed.)

WELDWOOD Plastic Resin GLUE gives strong, tight enduring joints, dowels that stay put, and inlays that won't belly. **WELDWOOD GLUE** is **WATERPROOF**, **ROTPROOF** and **STAINFREE**. It is a one-part, cold-setting synthetic resin—no hardener to add, no heat. Mixes instantly with a little tap water—ready for immediate use, without need of tricky formula or instructions.



10¢-25¢-50¢-85¢

You will be astounded by the results in your own shop work, realize why **WELDWOOD** is the glue approved and preferred for aircraft, marine, professional woodworkers, building, and industry. It's really a miracle glue.

UNITED STATES PLYWOOD CORP.

World's largest producers of Plywood

616 WEST 46th STREET, NEW YORK, N. Y.

If your hardware dealer can't supply you send coupon below.

WELDWOOD
PLASTIC RESIN
WATERPROOF GLUE

United States Plywood Corp., N. Y.

PSM

Please find enclosed 25c in coin for which send post paid generous can of **WELDWOOD GLUE** and complete **GLUE MANUAL** without usual cost.

Name

Address

(My dealer is))

FIRST and
FINEST

H
A
N
D
E
E

TOOL OF 1001 USES

A whole toolshop in your hand. For precision work on metals, alloys, plastics, wood, horn, bone, glass, etc. For your own hobby enjoyment or as a gift. Uses 300 easy-to-change accessories to grind, drill, polish, cut, rout, carve, saw, sand, sharpen, engrave. 25,000 r.p.m. Weight 12 ounces.

With 7 Accessories, postpaid . . . \$18.50



MAKES HAMMER-SMITHING EASY

Artizan

800
Strokes
a Minute

With this new tool marvel, anyone can now make, for a few cents each, valuable articles from copper, aluminum, pewter, brass or silver, and give them a beautiful hand hammered finish. A fascinating new hobby or a means to earn money.

Hammers, surfaces, sinks, shapes, forms, pierces, engraves, files, does repousse work. Plugs in any socket. Wt. 1 1/2 lbs.

With Accessories, \$29.50

Chicago Wheel & Mfg. Co.

115 S. Aberdeen St.
Chicago, Ill.

FREE: 64-PAGE CATALOG

ORDER EITHER TOOL ON
10 DAYS MONEY-BACK TRIAL



WINN'S New Idea

CHEMICAL KITS and APPARATUS OUTFITS for STUDENTS, BIG VALUE. FREE LITERATURE and CATALOG of CHEMICALS & LABORATORY SUPPLIES, SCIENTIFIC BOOKS at BIG DISCOUNT. Send 3c for return postage.

J. H. WINN MFG. CO.
Dept. 110—124 W. 23 St., N. Y. C.

Bandsander READY!

New Tool for
Home and
Industrial Shops

ONLY \$14.95

F. O. B.

Sensational new Mead Bandsander ready for craftsmen, model-makers, workshops, factories. Quickly cuts, shapes, sands irregular edges inside or outside! Works wood, plastics, metals. Long abrasive surface for cool, fast action. Tilting table for bevelling.

5 days FREE TRIAL. Money back if you are not 100% pleased. Order now to insure early delivery. Dealers—write for proposition!



MEAD SPECIALTIES CO. 15 S. Market St., Dept. 1101, Chicago, Ill.



With the Inventors

SLIP COVERS for automobiles protect the finish from rain, snow, dew, sunlight, and the salt moisture of seaside air, in a design worked out by Bridgle Rowan of Chicago. Slide fasteners make quick work of putting on or removing the



waterproof fabric. Elastic strips encircle its lower edge to make it fit the car snugly. If the user wants to drive a short distance with the cover on, he simply folds down a flap in front of the windshield, and enters the car through a side opening shown in the drawing. When the car is to be lighted after dark, slots at front and rear expose the headlamps and tail light. The rear slot also permits the license plate to be displayed, to conform to police regulations, when the car is left parked on a street. . . . BRINGING THE EFFICIENCY of office furniture into the home, a kitchen chair invented by Hamer K. Jett and Howard L. Showalter, of Brooksville, Ky., provides a pair of convenient, built-in tables. When these are



extended, a housewife may use them for shelling peas, peeling potatoes, and a whole variety of other tasks that call for a place to put something to work on and a second place for the finished work. The small, circular tables fold out of the way beneath the chair seat after use. Spring plates keep the tables steady while ex-

tended, so that they will not swing about and spill their load; and also come into play to hold the tables in the folded position. . . . "SCREW STICKS," or strings of

(Continued on page 233)

JIG SAW \$17.75

COD or outside
U.S.A. \$2.00

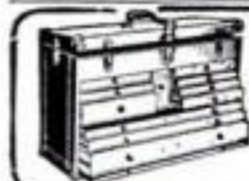
Including 13 assorted blades, Adapters, and roller Saw Guide formerly found on expensive machines only. All metal, 15" long, 8" high, 6 1/2" table. A swift and easy cutter—best ever made for the money.

A J. & H. Metal Product.

FREE CATALOG

describing complete power tool line: Shaper, \$3.25; Circular Saw with oilless bearings, \$3.50; Drill Press, \$2.75; completely equipped Lathes, \$2.25 and \$5.40; Sander, \$1.10; Jointer, \$7.25, etc. Sold direct only. Order today or send card for Catalog.

Taylor-Shantz, Inc. 3 Commercial St. Rochester, N. Y.



GERSTNER Tool Chests

Superior Workmen Recognize the Superior Workmanship of GERSTNER Chests. Free Catalog for Machinists and Toolmakers.
GERSTNER TOOL CHESTS
540 Columbia St. Dayton, Ohio

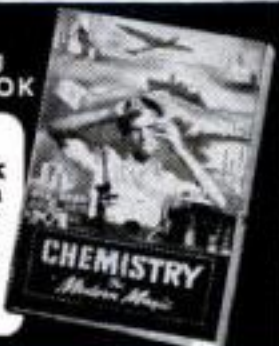
IT'S FREE

This Exciting NEW BOOK

"Chemistry—the Modern Magic"

BOYS! This new Chemcraft Chemistry book describes mystifying experiments you can perform in your own home. Tells of big future opportunities for boys interested in chemistry. It's Free . . . send for it Today.

THE PORTER CHEMICAL COMPANY
24 Prospect Ave., Hagerstown, Md.



We can buy it for you IN THAT DISTANT CITY

through Western Union Shopping Service. You describe it . . . we will buy it and see that it is delivered on time. Free telegram with each order. Ask for details at any Western Union office.

DECORATIVE METAL WORK

A brand new manual for the amateur. Tells in easy to understand language how to make useful metal articles in your home workshop. You'll be surprised how easy and interesting metal work really is. Fully illustrated with diagrams and step-by-step instructions. Sturdy cloth binding, 253 pages. Send only \$2.00 and your copy will be sent postpaid.

POPULAR SCIENCE MONTHLY—Dept. 101

353-4th Ave.

New York, N. Y.



SENSATIONAL Flexible SHAFT TOOL

It's the FOREDOM, with PENCIL-SIZE HANDPIECE for "Finger-Tip" CONTROL. Does countless jobs quickly—on wood, metal, glass, plastics, etc. Grinds, polishes, drills, mills, etc. Motor operates on AC and DC. Send for FREE illustrated catalog.
FOREDOM ELECTRIC CO., Dept. 252, 27 Park Pl., New York, N.Y.

COMPLETE, \$14.95



USE YOUR BENCH SAW

With Our six in. tool steel cutters. Make mouldings, casings, drop-leaf tables, grooves, beading & jointing 1" wide 1 1/2" \$1.50. Postpaid. State size hole. List & folder free.
John A. Sandstrom, Dept. 5, Jamestown, N.Y.



Get this New
1000-SHOT

RED RYDER CARBINE

Write for **FREE**
NEW CATALOG

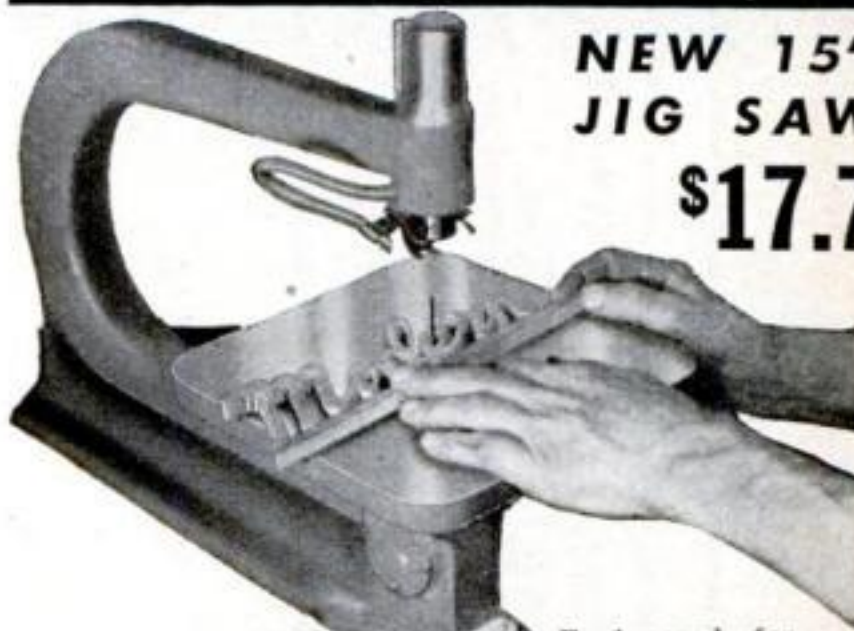
DAISY AIR RIFLES \$2.95

Carry this genuine Cowboy Style Carbine—Daisy's new RED RYDER CARBINE featuring: 16" Leather Saddle Thong on genuine Western CARBINE RING! Golden Bands! Red Ryder BRAND on Pistol Grip Stock! 1000-Shot Repeater! Lightning-Loader Device! \$2.95 at Dealers. If he hasn't it, send us \$2.95. We'll mail yours postpaid. (Duty added in Canada).

DAISY AIR RIFLES
DAISY MANUFACTURING COMPANY
5510 Union St., Plymouth, Mich., U.S.A.

Power King

WOODWORKING TOOLS OF TESTED QUALITY



NEW 15" JIG SAW

\$17.75

Engineered for smooth blade action on light veneers, plastics, thin metals, and boards to 2" thick. Takes 1/4 or 1/3 H.P. motor. Full details in new catalog.

Send for
FREE
Catalog

POWER KING TOOL CORP., 1007 Cleveland St., Warsaw, Ind.

Please send catalog. I am interested in ☐ Jig Saws ☐ 7", 8" Saws. ☐ Wood Lathes ☐ Drill Presses ☐ Spindle Shapers ☐ Jointer Planers ☐ Belt and Disc Sanders

Name.....

Address.....

City and State.....

TRAFFORD PLASTICS

For catalog, samples, 48-page Trafford Portfolio, send 25c (returned on 1st \$1.00 order). Experimental Kit \$3.00 pstd. Trafford, Dept. 804, 360 Worthington St., Springfield, Mass.

ONAN ELECTRIC PLANTS ALTERNATING AND DIRECT CURRENT



Produce Current, same as City Power Lines, for FARMS, SCHOOLS, THEATRES, PUBLIC BUILDINGS . . . Operate Lights, Radios, Motors, All Appliances.

Over 40 STOCK MODELS—350 to 50,000 Watts.

Any Voltage—Any Frequency.

Combination A. C. - D. C. Types.

Manual, Full Automatic and Self-Starting. \$99 up.

Shipped—COMPLETE, READY FOR OPERATION.

THOUSANDS IN USE IN ALL PARTS OF THE WORLD

Write for Complete Details.

D. W. ONAN & SONS

1480 Royalston Avenue - MINNEAPOLIS, MINN.



FOR QUICK AND EASY CUTTING USE A DURO BAND SAW

From our 9 1/2" Band Saw to our 16" Production Saw you will enjoy a new standard of smoothness, rigidity and accuracy in band sawing. Many features are built into these saws that make each one an exceptional value. Catalog E-41-B describes in detail our complete line of tools, a copy will be sent free.

DURO METAL PRODUCTS CO.
Dept. HH-22, 2649 N. Kildare Ave., Chicago, Ill.

DURO TOOLS ARE BEST



**WHO SAID
GOOD BLADES
HAVE TO BE
HIGH PRICED?**

Now you can enjoy a
smoother faster shave
and save money too!

Marlin
HIGH SPEED
BLADES

DOUBLE EDGE
**20 FOR
25¢**

Single Edge 15 for 25¢

GUARANTEED BY MARLIN FIREARMS CO.—FINE GUNS SINCE 1870

WORLD'S SAFEST SAW!

\$12.75
in U.S.A.



New, powerful magnetic SYNCRO
jig saw ready for craftsmen! Cuts
3/4" soft and 1/2" hard wood, thin
metal, plastics—smoothly, quickly,
safely! 13 1/2" throat clearance! 14-
400 Strokes Per Minute—7200
down cutting strokes,
7200 upward non-
cutting, repelling
SAFETY strokes!
No motor to buy—no
oiling! No rotating
parts to wear. Lasts a
lifetime. Portable.
Just plug in—and saw!
Only \$12.75 at Deal-
ers. If he hasn't it,
send check or M.O.; we'll ship
direct postpaid in U. S. A. Satisfaction Guaranteed!



FREE Catalog shows all fa-
mous Syncro Jig saws,
project books. Write for your copy!

SYNCRO WORLD'S SAFEST **SAWS**

SYNCRO DEVICES, INC., 3265 Bermuda, Dept. PS-101
Ferndale-Detroit, Mich.

**FUEL SHORTAGE
—BIG DEMAND
FOR WOOD**

**TURN TIMBER INTO CASH
WITTE LOG SAWS**

Start a wood sawing
business. Get steady cash clearing land,
cutting firewood. One man cuts 15 to
40 cords a day on a little cheap fuel.
Make Ties, Fence Posts, Shingle Butts,
etc. Use portable
engine for other money-making power
jobs. Low factory price. Easy terms.
ENGINES —Gas, Gasoline, Kerosene, Dis-
tillate. Size and style for every
need. 3 to 10 H. P. Enclosed; Self-Oiling; Roller
Bearing. Low power costs. Write free catalog.
WITTE ENGINE WORKS
4227 Oakland Ave. Kansas City, Mo.



BE PREPARED! LEARN TO SHOOT WITH BENJAMIN

Made in U. S. A.

**For Target—Small Game—Camping. Guar-
anteed—Accurate—Practical—Economical—Safe—
Clean—Quiet. Adjustable Force—Amazing Maximum
Velocity. No Smoke or Fumes. Bolt Action—Hammer
Fire—Hair Trigger—Safety Lock—Hand Pump. Single Shot
BB with 1 lb. shot \$8.50; Single Shot cal. 177 or 22 rifled—with
500 pellets \$10.00; Holster \$2.00. Also a complete line of Benja-
min Genuine Compressed Air Rifles for BB and cal. 177 or 22.
No license required from dealer or factory. Write Today for complete
specifications and free targets.
BENJAMIN AIR RIFLE CO., 852 Marlon St. St. Louis, Mo., U.S.A.**



**NOW a DYNAMIC
HEAVY DUTY
INDUSTRIAL WELDER**

**WORKS OFF 110-Volt Light
W Socket. This marvelous
Dynamic Power Welder does the
work of much higher priced types. It is RETAIL
easily portable. WELDS Cylinder Blocks,
Bumpers, Fenders, Tanks, Farm Machinery,
etc. Will also solder and braze on the lightest
material. Works on iron, steel, tin, brass, cop-
per and all other metals. Men without previous
experience can make as much as \$5.00 on a one
hour repair job. In a year's time a Dynamic Welder
COSTS LESS THAN 6 CENTS A DAY**

Go into business—Open a welding shop now. **AGENTS**—Make big
profits selling to garages, factories, janitors and machine shops.
Write today for our 10-DAY TRIAL OFFER, **DYNAMIC WELDER
COMPANY**, 2226-SG SILVERTON ROAD, CHICAGO, ILLINOIS



FACE Drill SHARPNER

NEWEST THING IN DRILL SHARPENERS • MAKES DULL AND
BROKEN DRILLS LIKE NEW IN FEW SECONDS • HANDLES
FROM 3/32 TO 1/2 INCH • FOR ALL BENCH GRINDERS



Fits any grinding wheel

**5-DAY FREE TRIAL. MONEY-
BACK GUARANTEE**—Shipped
prepaid upon receipt of \$5.95.

or C.O.D. Money refunded if not completely satisfied.

NOTHING TO RISK—ASK TO SEE IT State diameter
and number of threads per inch on grinder shaft when ordering.

LINDEN-SHEPPARD COMPANY • Dept. 5 • 33 WEST 51st ST., NEW YORK CITY
GENERAL OFFICES: NEW YORK CITY • FACTORY: DETROIT, MICHIGAN

NOTHING LIKE IT ON MARKET
Equals work of higher priced
grinders...Simple as A-B-C

FREE FOLDER

now only
\$5.95
Postpaid
COMPLETE



New IMPROVED Electric MOTO-SAW

New Blade Hold-
er Faces Blade 4
Ways... Multi-
plies Capacity

**SAFE AS A HAND SAW
JUST GUIDE IT!**

More like magic than any tool
you ever saw. Imagine an
electric scroll saw only slight-
ly heavier than a hand coping
saw... a tool that takes no
effort to run, no pressure to
feed. Works at any angle—on
big assembly jobs or on the
tiniest piece you can hold in
your fingers. Runs 7200 strokes
a minute... so fast the blade
seems to stand still. Sturdily
built... only two moving
parts... never needs oiling.
Easily cuts intricate designs
—so smooth it eliminates sand-
ing. Novice or craftsman, a
thrill awaits you when you
get a Moto-Saw in your hand.

U.S. Patent 2233862
Other Patents Pending
DREMEL MFG CO.
Dept. S-121-K
Racine, Wisconsin

**NO LIMIT TO LENGTH
OF STOCK... WORK TO
CENTER OF 19" WIDTH**
It's fast... cuts on an
average of 1 ft. per
minute up to 3/4" me-
dium hard wood. Op-
erates on 110-120 V. 50
or 60 cycle alternating
current. If your dealer
does not yet have MO-
TO-SAW, send \$4.85
... we'll pay postage.
Or send \$1. pay post-
man balance plus post-
age. **MONEY BACK**
if not delighted after
5 days trial.



MODEL RAILROADERS

Send for the brand new, beautifully illustrated **WALTHERS CATA-
LOGUES** of model railroad equipment. HO Gauge... 32 pages
...10c. O Gauge... 112 pages... 25c.
W. K. WALTHERS Inc., 259 E. Erie St., MILWAUKEE, WIS.

METAL AND WOOD WORKING MACHINE TOOLS



Send for new **FREE** catalog of complete
line of Machines, Motors and Accessories

WALKER-TURNER CO., INC. • 2101 Berckman St., Plainfield, N. J.

BUILD ARC WELDER FROM OLD GENERATOR

For Light or Heavy Work. 75-200 amperes.
Complete **PLANS** and valuable catalog
35¢. Over 1000 Electrical Supply Bargains.
LeJay Mfg. Co., 1323 LeJay Building,
Minneapolis, Minnesota



BIG FREE RADIO BOOK

Shows hundreds of radio parts, sets, accessories, am-
plifiers, ham gear, electric appliances and supplies.
Rock bottom prices, fast service, guaranteed quality.
Send for your copy today. Save at Radolek!

RADOLEK CO., Dept. PS-58, 801 W. Randolph St., Chicago, Ill.



Don't Gamble
Guard against trouble
from Minor Injuries—
Burns, Cuts

Scratches, Bruises or Scalds. Be wise. Guard against infections
which may "lay you up." Cleanse wound instantly. Then apply
effective, inhibitory antiseptic **OIL-O-SOL** (formerly Oil-of-Salt).
Used for over 40 years in thousands of factories, garages, industrial
first aid stations, fire departments and homes. Works four ways:
Combats infection; helps check oozing of blood; stimulates heal-
ing; quickly helps relieve pain. Only 50¢ at your druggist's. Must
satisfy you or your money back. Get **Mosso's OIL-O-SOL** today.

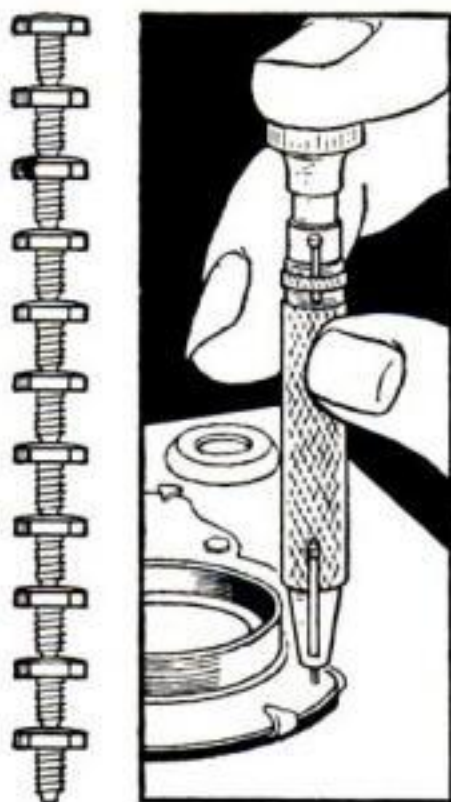
Please mention **POPULAR SCIENCE** when writing to advertisers.

With the Inventors

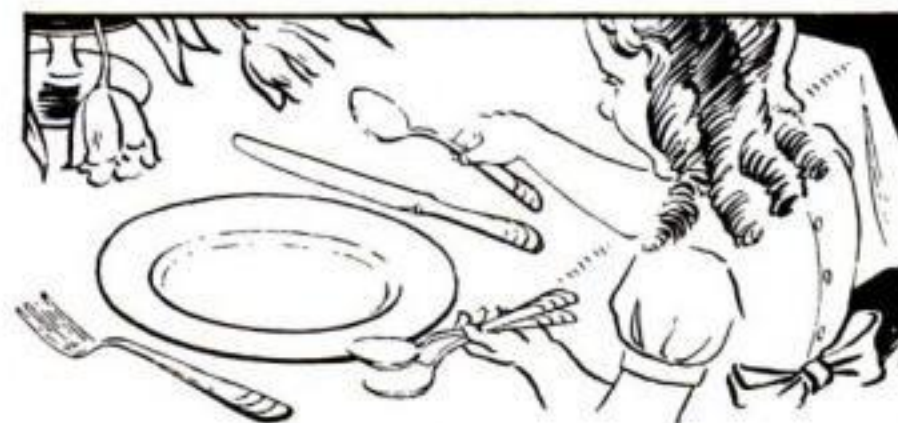
(Continued from page 230)

screws easily broken apart, and a magazine screw driver for inserting them, have been devised by Miller R. Hutchison, Jr., of Rochester, N. Y. His method is called especially useful for driving quantities of extremely fine screws like those used in camera shutters

and watches. Hitherto it has taken considerable skill to seat such a screw firmly enough so that it will not come loose, without exerting too much pressure and stripping the thread. In this inventor's scheme, however, the breakable necks between screws will automatically shear off when just the right tension has been reached. Convenient lengths of screw sticks contain from 20 to 50 screws apiece. As one screw is broken off, the next one slides into place at the tip of the screw driver, making for handy and rapid application. . . . IF YOU BELIEVE you have an invention of value to national defense, the place to send it is the National Inventors Council, Washington, D. C. Or, if you are applying for a patent, it will automatically be considered for its possible military merits. . . . SETTING A TABLE becomes easy for a child, with knives, forks, and spoons that can hardly be put down at the wrong side of the plate. Handles are designed with straight edges facing the inside, or with one-sided ornamentation



such as inwardly curving lines, so that they form a symmetrical design when properly arranged. Decorative as well as practical, the invention has been assigned to a leading



such as inwardly curving lines, so that they form a symmetrical design when properly arranged. Decorative as well as practical, the invention has been assigned to a leading

(Continued on page 234)



DAYS that might have been duds are thrilling experiences with SUPER-X. Time and again you marvel at the way SUPER-X sends an old drake into a spin—and each experience like that shows you the importance of SUPER-X short shot string! . . . You take home ducks.

	WESTERN CARTRIDGE COMPANY	
	Dept. J-16, East Alton, Illinois	
	Please mail, FREE, the new 76-page Western Ammunition Handbook and your new folder giving full particulars of SUPER-X and XPERT shot shells.	
	Name _____	
Address _____		
Post Office _____		State _____

WARNING! PAINT BRUSH PRICES ARE GOING UP!

Keep Your Paint Brushes Soft, Clean This New, Easy Way

Bristle shortages and high costs now make this new product unusually important to all who paint. No need now to waste money or let brushes get stiff and matted—Keepkan Paint Brush Cleaner easily, inexpensively, automatically cleans brushes . . . actually draws the pigment out . . . as if by magic! Just hang wet brush overnight in Keepkan Liquid . . . it's soft and clean by morning. Get Keepkan now—popular large size Keepkan (enough for 20 or 30 cleanings), complete with Liquid and patent Brushanger—

ONLY 25c at most 5 and 10c stores and other paint dealers.

THE HOWE COMPANY

Dept. S • Springfield, Mass.



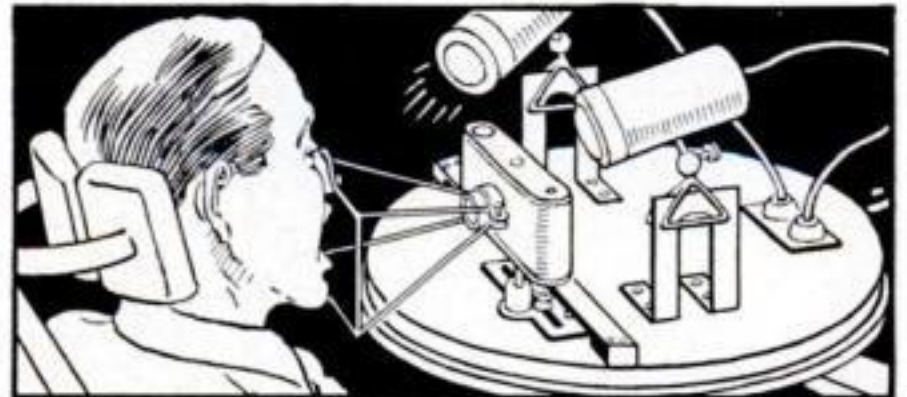
KEEPKAN

PAINT BRUSH CLEANER

With the Inventors

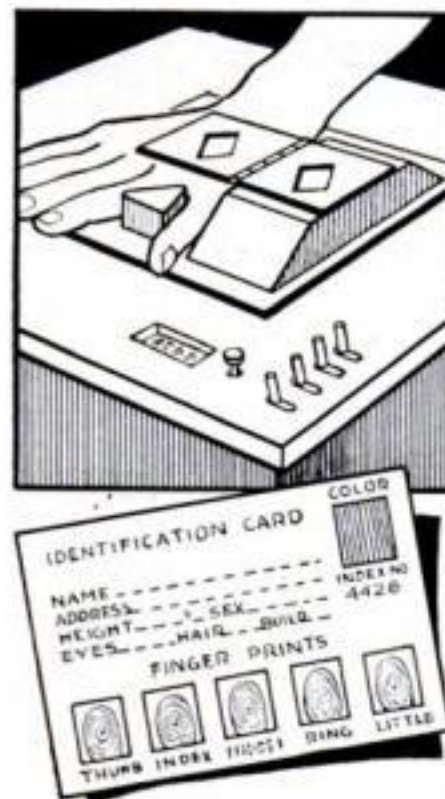
(Continued from page 233)

American maker of silverware by Marion C. Vonderheid, of Long Lake, Wis. . . . A CAMERA FOR DENTISTS, quickly swung into position for use, affords a ready means to photograph the teeth or bone structure of a patient. At his leisure, the dentist



may then study an enlargement of the picture, and make detailed plans for the kind and amount of work needed, without having to rely on memory or elaborate measurements. As designed by William F. Upton of San Anselmo, Calif., the camera and a pair of lamps are mounted as a unit on a standard dental bracket table. A wire frame with a loop for the nose serves as a guide in bringing the camera into focus, and assures that pictures made from time to time will be similarly centered for comparison. A sliding base mounts a universal joint for adjusting the camera. . . . WHAT COLOR IS YOUR SKIN? Grading it with the utmost precision is the object of a "color analyzer" devised by John F. Wilson of

Washington, D. C. Entered with other personal characteristics, on a police card for civilian or criminal files, the resulting index number may help to identify a victim of accident or amnesia, or prove the guilt or innocence of a suspect in a crime. To have the hue of his skin classified, a person simply places his hand on a cabinet



net beneath a diamond-shaped window. Then a motion-picture film, bearing thousands of tints for comparison, passes beneath a similar window until the colors

(Continued on page 236)



Fix your crippled furniture, chipped veneer, splintered moldings so they look like new . . . Rogers Glue stays put longer because it's stronger . . . also useful for repairing sporting goods, leather, cabinet work, wooden drawer pulls, interior building construction, and the like.

ROGERS ↓
3,000*
Waterproof glue
Resin glue ↓
*450 *500
COMPARATIVE STRENGTHS
*Lbs. per sq. inch

Special Offer! Sells 10 cents and up in tube, jar or can at hardware stores only or send 10 cents for full-size jar, a free project book giving new ideas, new plans on how to make useful articles, plus a free set of project sheets
DEPARTMENT M.
ROGERS GLUE CO.,
Gloucester, Mass.

ROGERS

A TON OF STRENGTH IN EVERY DROP



Black-on-white! The crack-proof white surface is bonded to the steel—protects it from rust. Favorite Wyteface is easy to clean, hard to kink, durable. *Guaranteed for one year.* 25, 50, 75 and 100 ft. lengths. Mail coupon today for free sample of the line and illustrated folder.

K&E FAVORITE WYTEFACE
STEEL MEASURING TAPES

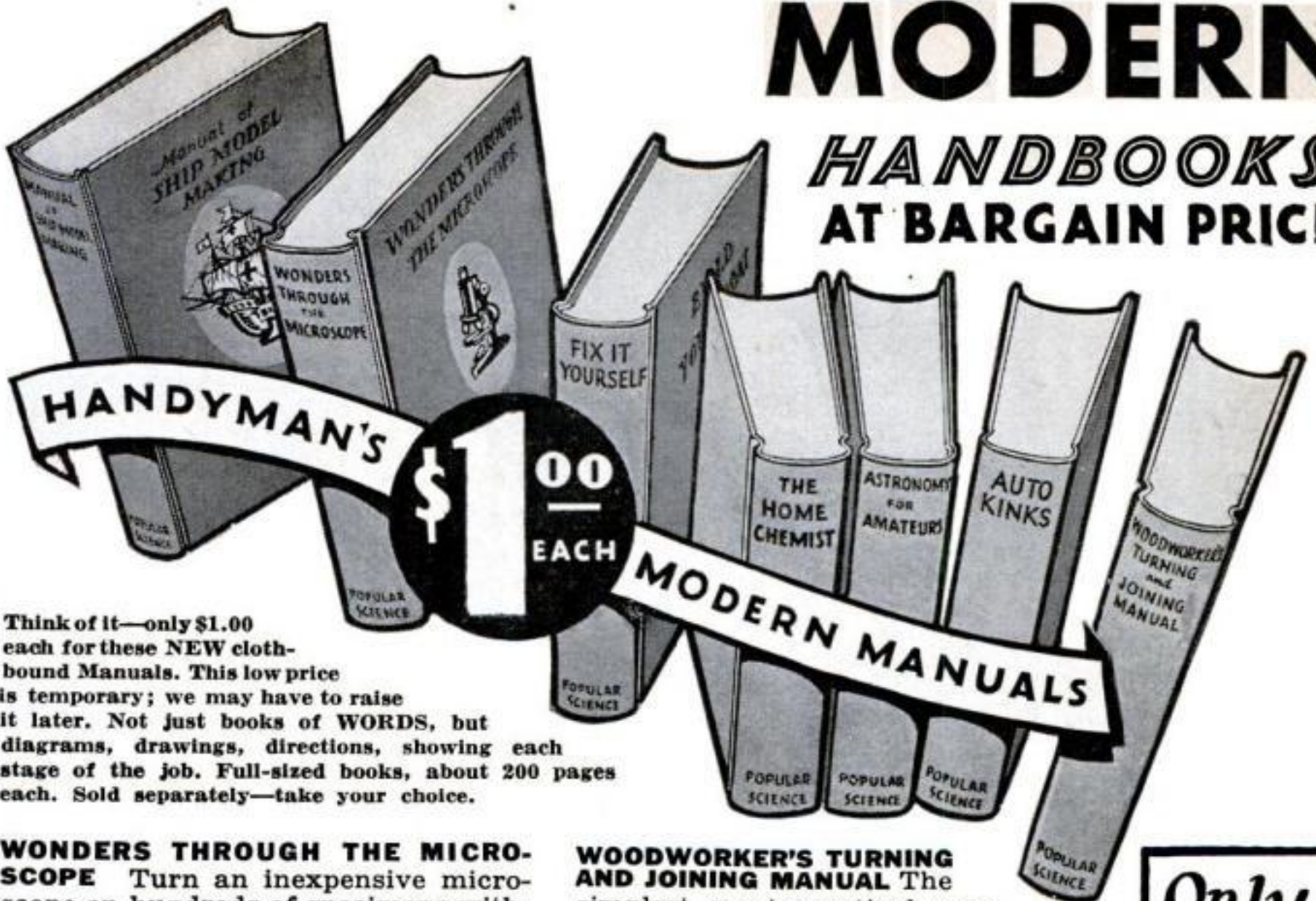
LOOK FOR THIS DISPLAY



KEUFFEL & ESSER CO., Est. 1867
Dept. 146, Hoboken, N. J.

Name _____
Address _____
City _____ State _____

MODERN HANDBOOKS AT BARGAIN PRICE



Think of it—only \$1.00 each for these NEW cloth-bound Manuals. This low price is temporary; we may have to raise it later. Not just books of WORDS, but diagrams, drawings, directions, showing each stage of the job. Full-sized books, about 200 pages each. Sold separately—take your choice.

WONDERS THROUGH THE MICROSCOPE Turn an inexpensive microscope on hundreds of specimens within a stone's throw of your front door and you step off into a new world of wonders. Complete Manual for amateurs. How to use equipment, secure and preserve specimens, take photomicrographs, etc. Numerous illustrations. Full cloth bound \$1.00.

AUTO KINKS Car owners and service man's handbook of working diagrams, pictures, instructions, now reprinted in book form from Popular Science. The best ideas from among thousands. Will save many dollars and keep your car in tip top shape through many jobs you can now do easily. Cloth bound \$1.00.

THE HOME CHEMIST How to set up and operate an inexpensive home laboratory with odds and ends of material available in every home. Many thrilling, practical, useful experiments and tests, entertaining, instructive, valuable, pointing the way to research and new discoveries. Many diagrams and illustrations. Full cloth bound \$1.00.

MANUAL OF SHIP MODEL MAKING How to make any model. Here are clearly diagramed the many short cuts, kinks, and time-saving methods of experts. Complete plans and speci-

WOODWORKER'S TURNING AND JOINING MANUAL The simplest, most practical ways to make end tables, chairs, benches, highboys, book-racks, cabinets, all kinds of furniture, in your spare time. A revelation of simplicity and helpfulness. Many illustrations. Full cloth bound \$1.00.

FIX IT YOURSELF A new edition of a famous book, showing with diagrams and directions, how to fix and repair furniture, electric outlets, windows, doors, leaky pipes, floor boards, chimneys, boilers, weather proofing, painting and hundreds of other construction and repair jobs. Full cloth bound \$1.00.

ASTRONOMY FOR AMATEURS Easy ways to know the heavens with simple, home-made equipment, charts and guides. Opens up new worlds of wonderment—a gloriously fascinating and instructive hobby for the whole family. Many illustrations. Full cloth bound \$1.00.

Only
\$1
each

TAKE YOUR CHOICE
Use Coupon Below

SEND NO MONEY!

fications for a gorgeous galleon, clipper ship, etc. Almost 100 illustrations. Full cloth bound \$1.00.

POPULAR SCIENCE MONTHLY,
353 Fourth Ave., New York, N. Y.

Dept. 101

Send me the Manuals checked below.

Microscope \$1.00
Auto Kinks \$1.00
Home Chemist \$1.00
Ship Model \$1.00

Woodworkers \$1.00
Fix It \$1.00
Astronomy \$1.00

When the books arrive I will pay the postman price shown beside each book ordered plus a few cents postage. You are to refund what I have paid if I return the books within five days of their receipt.

NAME.....

ADDRESS.....

CITY.....

"TOPS" FOR FAST CLEAN CUTTING



ATKINS Clearance Grind CIRCULAR SAWS

To get top results from your table or arbor saw, put in one of these modern blades. Clearance starts right at the tooth edge. That's why the saw runs cooler... why it turns out smoother, sliver-free work at top speeds... needs less filing. See one at your hardware dealer.

E. C. ATKINS AND COMPANY
428 S. Illinois St., Dept. S, Indianapolis, Ind.



ATKINS SAWS

Silver Steel



Complete Plans and Building Instructions, 10c

FREE TRAILER PARTS CATALOG

We'll save you money on—axles, springs, wheels, couplers, windows, sinks, water pumps, brakes, refrigerators, beds, lamps, inside and out, 6V lamps, furniture, jacks—everything. Special discount to mfrs. **NATIONAL TRAILER EQUIPMENT CO.** Successors to Kar-A-Van Industries, Inc. Dept. S-5-714 W. Wisconsin Ave., Milwaukee, Wis.



ACE
LATHE TOOL SET
\$14.50

Be permanently tooled-up for every operation on your Metal Cutting Lathe

The ACE Set is complete—there's nothing more to buy. Drop forged by the manufacturers of cutting tools used by 96 per cent of the plants and shops in industry, they are correctly designed, are of special steel, are finely finished, are stronger—will last a lifetime. You can cut easier, faster and more accurately with ACE TOOLS. At your Hardware Store—Circular FREE.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
329 N. Francisco Ave., CHICAGO, U.S.A.

BE PREPARED! LEARN TO SHOOT WITH BENJAMIN



MADE IN U.S.A.

22

HARD ACCURATE SHOOTING WITH CHAMBERED AIR

You can use new model BENJAMIN AIR RIFLES WITH LEVER HAND PUMP anywhere, for practice firing or just plinking, around the house or camping, fishing, hunting, etc., at lowest cost. Shooting force is adjustable with amazing maximum power and accuracy—no recoil or forward lunge to disturb your aim. Bolt Action-Hammer Fire-Hair Trigger-Safety Lock-Hand Pump. Single Shot BB with 1 lb. shot \$8.50; Single Shot Cal. 177 or .22 rifled—with 500 pellets \$10.00. Also a complete line of BENJAMIN GENUINE COMPRESSED AIR PISTOLS from dealer or factory. Write for details and FREE TARGETS. BENJAMIN AIR RIFLE CO., 893 Marion St., St. Louis, Mo., U.S.A.

WOODWORKERS

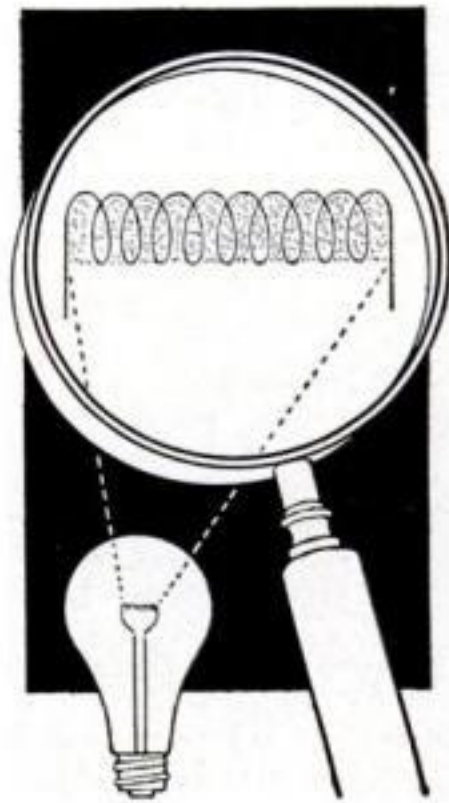
1941 MASTER MANUAL

Get the Brand New Constantine Master Manual for Woodworkers and Big 1941 Bargain Book, listing and describing over 100 different kinds of wood and 980 different items in veneers, lumber, panels, inlay work, turning squares and helpful woodworking tools. All at big money-saving prices. Indispensable to expert or beginner. Printed and illustrated articles on How to Make Inlaid Pictures; How to Make Veneered Panels; How to Finish Different Kinds of Woods. A source of supply for you in any quantity—large or small—every kind of wood you are looking for. Send 25c today in stamps or coin. 25c refunded or credited on first order, so Manual costs you nothing. **ALBERT CONSTANTINE & SON, INC.** 793-T East 135th St., N.Y.C.

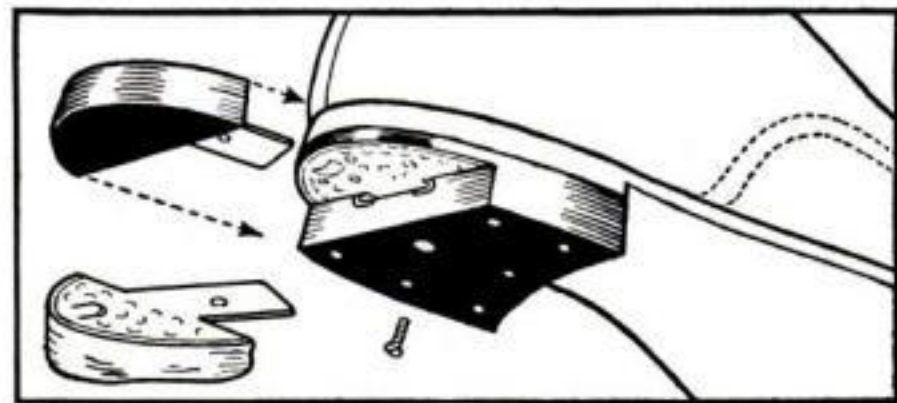
With the Inventors

(Continued from page 234)

exactly match. Each frame of the movie film is numbered, and the corresponding number is recorded on the identification card. According to the inventor, "black," "white," and equally broad classifications now in use offer scant aid, since as many as 1,000 gradations of skin color may be found in persons of either Caucasian, Negro, Mongolian, or Malayan race. . . . MANTLES FOR ELECTRIC LAMP BULBS have been patented by Anton Kratky of New York. Like gas mantles, they employ rare earth elements, and their incandescence provides added illumination. More im-



portant in the inventor's view, however, they provide a support for the coiled filament, preventing its loops from sagging together and causing a short circuit. In addition, the filament may be heated to a higher temperature than normal, giving a marked increase in the brilliance of the light. For making the mantle, experiments have indicated the best material to be thorium oxide. . . . WORN-DOWN RUBBER HEELS become as good as new, with a replaceable wearing surface originated by Frederick A. W. Kelley of Pawtucket, R. I. The most wear, he observed, usually took place at the outer rear edge of the heel. Therefore he designed a heel in which this part was detachable, while the rest was permanent. By



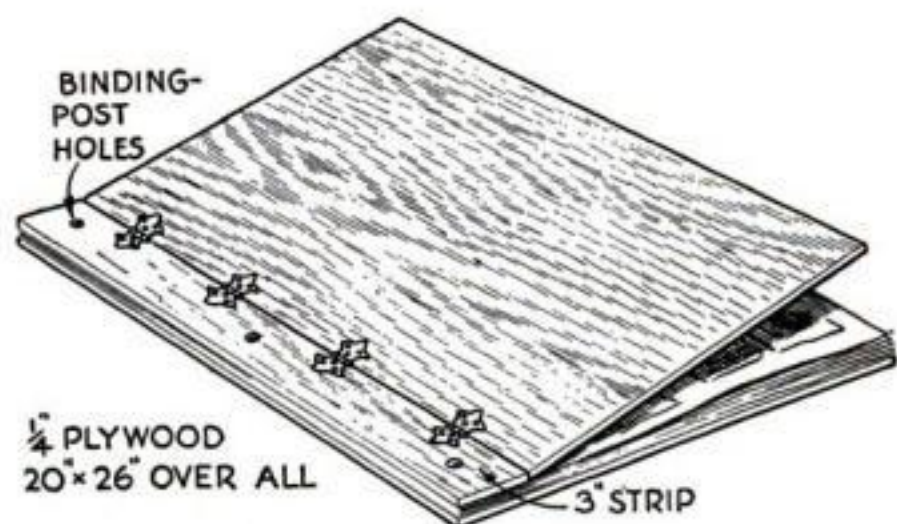
extracting a small screw at the center, the run-down portion is freed and may be discarded. A new section is then inserted, as shown in the diagram, and the screw is replaced.

Please mention POPULAR SCIENCE when writing to advertisers.



Hand Vacuum Cleaner Removes Loose Hairs from a Dog

THE annoyance of finding dog hairs all over the furniture and rugs may be avoided with short-haired breeds of dogs by applying a hand vacuum cleaner or the hand attachment of a large vacuum cleaner to the dog as illustrated above. The cleaner takes out all loose hairs and gives "Rover" a clean, glossy appearance.—E. H.



Oversize Scrapbook Contains Whole Newspaper Pages

IF YOU have been plagued with the trouble of trying to paste large clippings into a scrapbook much too small, make a pair of oversize covers from $\frac{1}{4}$ " plywood as shown. This book is 20" by 26", and the pages are full-size newspaper proof sheets. A strip 3" wide is ripped from one piece of plywood and fastened with four small hinges. Three loose-leaf binding posts, which can be bought at any well-stocked stationery store, hold the book together.—ROY N. JERVIS.

ASPHALT paint is excellent for iron picket fences. It gives a good black finish and resists all weather conditions.—L. M.

Save on Everything in Radio



FREE!
**RADIO'S
GREATEST
CATALOG!**

LOWEST PRICES ANYWHERE

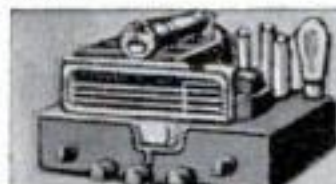
It's completely new—it's sizzling hot—it's got all the money-saving values you expect from ALLIED on Everything in Radio!

50 NEW 1942 RADIOS!

Every one a champion value—"Personal" 3-way Portables; latest FM-AM models; Recorders; Phono-radio Combinations; Plastic models; World-wide models; Auto and Farm radios; new Amateur sets—all at lowest prices!

NEW 1942 SOUND SYSTEMS!

The latest—for every Public Address application—7 to 60 watts. New features—lowest prices in P.A. See our Time Payment Plan—15-Day Trial Offer. Don't miss these values!



**BUILD
YOUR
OWN!**



NEW 1942 KITS!

Build your own radio! Everything you need in radio for every building requirement. We'll supply parts lists for any circuit described in magazine radio construction articles. Let ALLIED help you—just ask us—you'll learn quickly. Make us your Radio Headquarters.

15,000 PARTS!

The biggest selection of quality parts. Every leading make—complete listings for every radio building and servicing requirement. You can't afford to be without the new 1942 ALLIED Radio Catalog—the reliable Guide to Everything in Radio at lowest Prices!



**LEARN
RADIO!**



RADIO DICTIONARY

Nothing like it ever before—complete, authoritative, worth many times the price! Compiled by leading Radio authorities under ALLIED Supervision. Gives easy-to-understand definitions of all commonly used radio terms. A "must" at only..... **10c**

BUILDERS' HANDBOOK

Most popular and widely sold Radio publication — ALLIED's own valuable beginner's book on Radio. Tells how to select circuits, read diagrams, build sets, etc. Fully illustrated. Easy to understand. Order by coupon. It's yours for only..... **10c**

ALLIED RADIO

833 W. Jackson Blvd., Dept. 7-K-1
Chicago, Illinois

- ☐ Send me your FREE 1942 Radio Catalog.
☐ I enclose 10c for Radio Dictionary.
☐ I enclose 10c for Radio Builders' Handbook.

Name.....

Address.....

City..... State.....



AT LAST!

**A FRICTION SOAP
THAT SOOTHES YOUR SKIN**



GET SAMPLE
FREE

Mail Coupon Below

MAR-BEL* FOR WELL-GROOMED WORKING HANDS

NO SAND OR PUMICE just quick-cleansing Calcium granules.

NO HARSH CHEMICALS just soothing lotions and Cold Creams.

NOT JUST A MECHANIC'S SOAP but an all-occasion cleanser for the whole family. Removes grease, rust, paint, etc., like magic. Wash up with MAR-BEL* for well-groomed working hands. Clinically approved by one of America's leading medical institutions.

AGENT
TERRITORIES
AVAILABLE

*Trade Mark

**COSMATA, INC., 10-15 48th Avenue,
Long Island City, N. Y. Dept. S**

Please send me a free sample of MAR-BEL, the new friction soap for well-groomed working hands.

NAME

ADDRESS

CITY STATE



Wood workers:

only
10c

Here it is! Harold Hunt's big 1941 wood catalog! Latest, **UP-TO-DATE IDEAS** for experts and amateurs; **SPECIAL BARGAINS** in rare woods, veneers, and **ALL** kinds of supplies. 148 pages—20 in color. Get posted! Send only 10c to
**CRAFTSMAN WOOD SERVICE CO.,
2729 S. Mary St., Dept. M-5, Chicago, Ill.**

EASY TO BUILD

U-MAK-IT

Cut to fit Boats for quick assembly. Complete with hardware—Everything you need plus Simple Illustrated Building Instructions. No Experience Necessary. Easy as A-B-C. Save and enjoy building your own.

RUSH—SEND TODAY for 2 money saving illustrated catalogs showing latest Lightweight Marine Plywood Construction. Largest selection we ever offered.

**KAYAK BOAT CO.,
152P-E 1st St., New York, N. Y.**



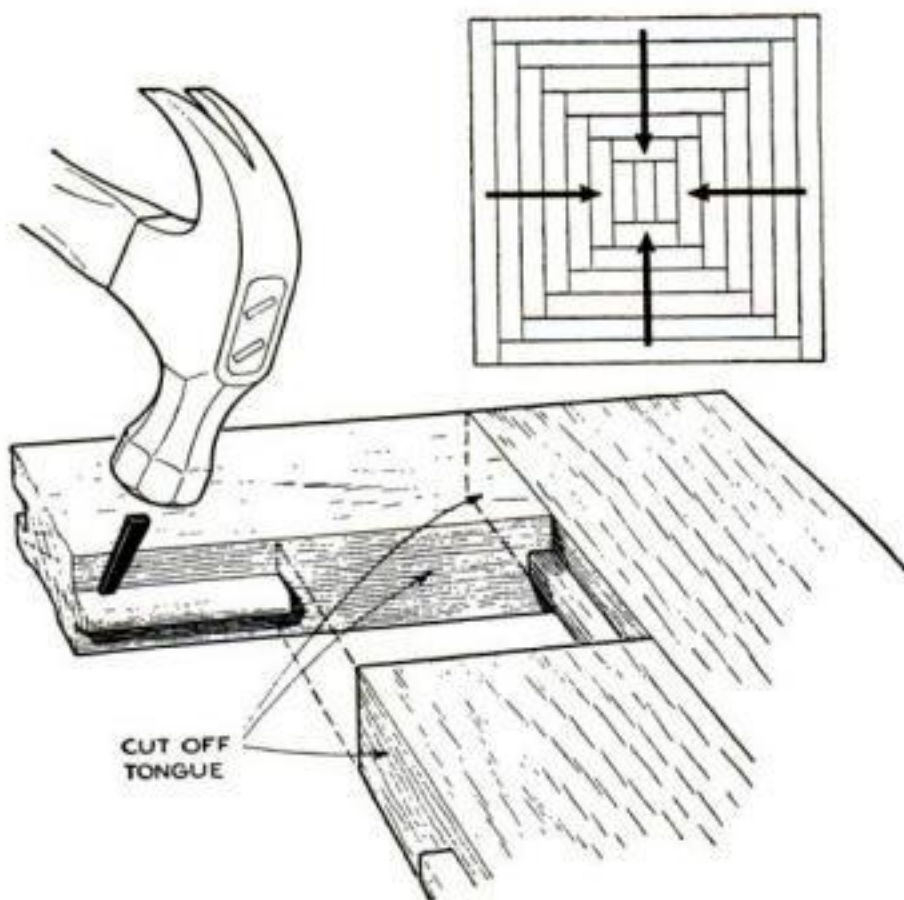
**KAYAKS
INBOARDS
OUTBOARDS
ROWBOATS
RUNABOUTS
DINGHIES**



How to Lay Flooring Strips in a Square Pattern

SQUARE-PATTERNED flooring, popular for use in hallways and alcoves and on stair landings, can be laid simply by beginning along the four walls and working toward the center as illustrated.

Blind-nail each frame of boards as you would a conventional run of flooring, first cutting away the tongue wherever necessary to permit inserting the succeeding frame. To insert the last, or center piece, which must be square edged and face nailed, the entire tongue of the preceding frame must be removed.



126Y-TJN-2BSN

This One



1Z6Y-TJN-2BSN

FOR 27,000 R.P.M. INSIST ON A GENUINE

MOTO TOOL

100 Tools in One

- *Has shock-proof bakelite case
- *Fan-cooled motor can't over-heat
- *Has oil-less bearings
- *Dynamically balanced armature



Here's guaranteed quality! The handiest tool in the shop or home. Used daily for model making, repairing, carving wood or plastics, etching glass or metal, touching up dies, sharpening, routing, sanding, drilling, and on a hundred other jobs. Higher speed does better work and saves cutters. **Model One**, wt. 6oz., with chuck and 1/8" collet, only \$9.95. **Model Two**, wt. 13 oz., \$16.50. **10 DAY TRIAL—Money-Back Guarantee.** If your dealer does not have Moto-Tool, order direct... we pay postage if you send cash. Or, send only \$1, pay postman balance plus postage. New catalog of tools and accessories **FREE**.

KIT NO. 1 with 23 high grade accessories and Model 1 Moto-Tool in \$17.50 hardwood case
KIT NO. 2 same as above with Master Model 2 \$23.50 Moto-Tool....

DREMEL MFG. CO.
Dept. T121-K
Racine, Wis.

FLUORESCENT WHOLESALE CATALOG FREE



The most complete fluorescent catalog—listing fixtures, accessories, kits for every type of fluorescent lighting—including newest kitchen and bed lamps—at lowest wholesale prices. New kit and diagram service makes it easy to assemble, install, and sell complete fluorescent for homes, stores, factories, offices and farms. Send for **FREE** catalog and special agents offer.

Jackson Fluorescent Supplies, PS-10, 205 W. Wacker Drive, Chicago

NEW ADV. MACHINE!

PRINTS AND ILLUSTRATES 1c POSTCARDS

Learn HOW hundreds of businesses are boosting sales with 1c Messages—produced on the spot with new, patented, **CARDMASTER**. Just send name for **FREE** illustrated book of money-making ideas for your business and complete Unique Advertising Plans. Write today.

CARDMASTER, 4546 Ravenswood, Dept. 1010, Chicago



Woodworker's Turning and Joining MANUAL

The simplest, most practical ways to make end tables, chairs, benches, highboys, bookracks, cabinets, all kinds of furniture in your spare time. A revelation of simplicity and helpfulness. Many illustrations. Full cloth bound \$1.00.

POPULAR SCIENCE MONTHLY, Dept. 101A
353 Fourth Ave. New York, N. Y.

MECHANICAL DENTISTRY

A profession offering unlimited opportunities. Most modern and complete course embracing every branch from Plate to Porcelain Work, which prepares you to work for Dentists or start your own business. Individual instruction—practical training in day or night school. No books—no classes. Catalog upon request.
McCARRIE SCHOOL OF MECHANICAL DENTISTRY
207 N. Broad St. Dept. 690 Philadelphia, Pa.

SAW-FILING

Pays up to \$2 or \$3 an Hour

A FOLEY Automatic Saw Filer files hand, circular and band saws better than the best hand filer. Cash business, no canvassing, no eyestrain. No experience needed. "Bought a Foley, one year later had all debts paid and \$400 on a new home. Many days I earn as much as \$16." —J. H. Kellogg. Send coupon for **FREE PLAN**, no obligation.

FOLEYMFG.CO., 1019-1 Foley Bldg., Minneapolis, Minn.
Send Free Plan on Saw Filing business.



Name.....
Address.....

WORK WONDERS WITH THE NEW BURGESS VIBRO-TOOL A BIG STEP FORWARD



120 STROKES PER SECOND

in design and ability to secure amazing results. Operating by vertical vibration, instead of rotary principle... writes on steel; cuts linoleum blocks; engraves on glass and metals; carves wood; literally "slices" cardboard; tools leather... finer, truer, faster work.

Insuring steady precision results, from rapid cutting or slicing motions.

J. W. HALL JEWELERS

ENGRAVE ON GLASS

For decorative effects, sign making or other glass work, Vibro-Tool creates "magic"... Cuts names, dates, numbers on tools and parts.



Really "100 tools in one", Vibro-Tool is indispensable for "1001" operations. For craft workers, for factory or other production work, there is nothing to approach it. Tool complete with assorted needles \$7.50 postpaid. Circular on request.

BURGESS HANDICRAFT SUPPLIES
178 N. WABASH AVE. CHICAGO, ILL.



6 WAY MEASURING - SPARE STEEL BLADE

For speed, accuracy, and ease of handling, the MASTER STEEL TAPE RULE tops them all.

- Gets outside, inside, length and depth with one hand.
- Can be used as a caliper.
- Has pistol-butt shaped case for easier handling.
- Precision lock to retain all measurements.
- "Spare" steel blade—easily snaps into place.

The special "No-Jam" tape mechanism of MASTER STEEL TAPE RULES checks kinks and curls. Permanent calibrations... easy to read. Case can be taken apart for cleaning.

It's a combination for an extra long useful life—a MASTER STEEL TAPE RULE with a "spare" blade.

The MASTER "Streamline" Model No. 406, with a 6-ft. tape 9/16" wide—double edge marking on one side, for only \$2.60 with "spare" blade, at most hardware stores or—use coupon.

STEEL TAPE RULE + A SPARE BLADE

Now \$2.60

MASTER RULES AND TAPES

Master Rule Mfg. Co., Inc., Dept. D, 815 East 136th St., New York, N. Y.
I enclose \$_____ for ☐ "Streamline" MASTER TAPE RULE, with spare blade for each to be sent postpaid.

Co. Name.....
Address.....
City..... State.....

Today You Need

SPEED

IN YOUR SHOP EQUIPMENT

NOW, more than ever, you need shop machinery that will produce more in less time. High spindle speeds are essential for the efficient use of modern sintered carbide and diamond cutting tools. Smooth, vibration-free operation at high speed is achieved in South Bend Lathes by using a direct belt drive to the spindle, a precision balanced spindle assembly and spindle bearing surfaces that are hardened, ground and superfinished to a smoothness of five micro-inches (.000005").

At right—10" Swing, 1" Collet Capacity South Bend Tool Room Precision Bench Lathe. This lathe has nine spindle speeds ranging from 50 to 1357 R.P.M., 1½" hole through spindle, 1" maximum collet capacity, 48 power longitudinal carriage feeds, 48 power cross feeds, and cuts 48 different pitches of screw threads.

SIZES OF SOUTH BEND LATHES

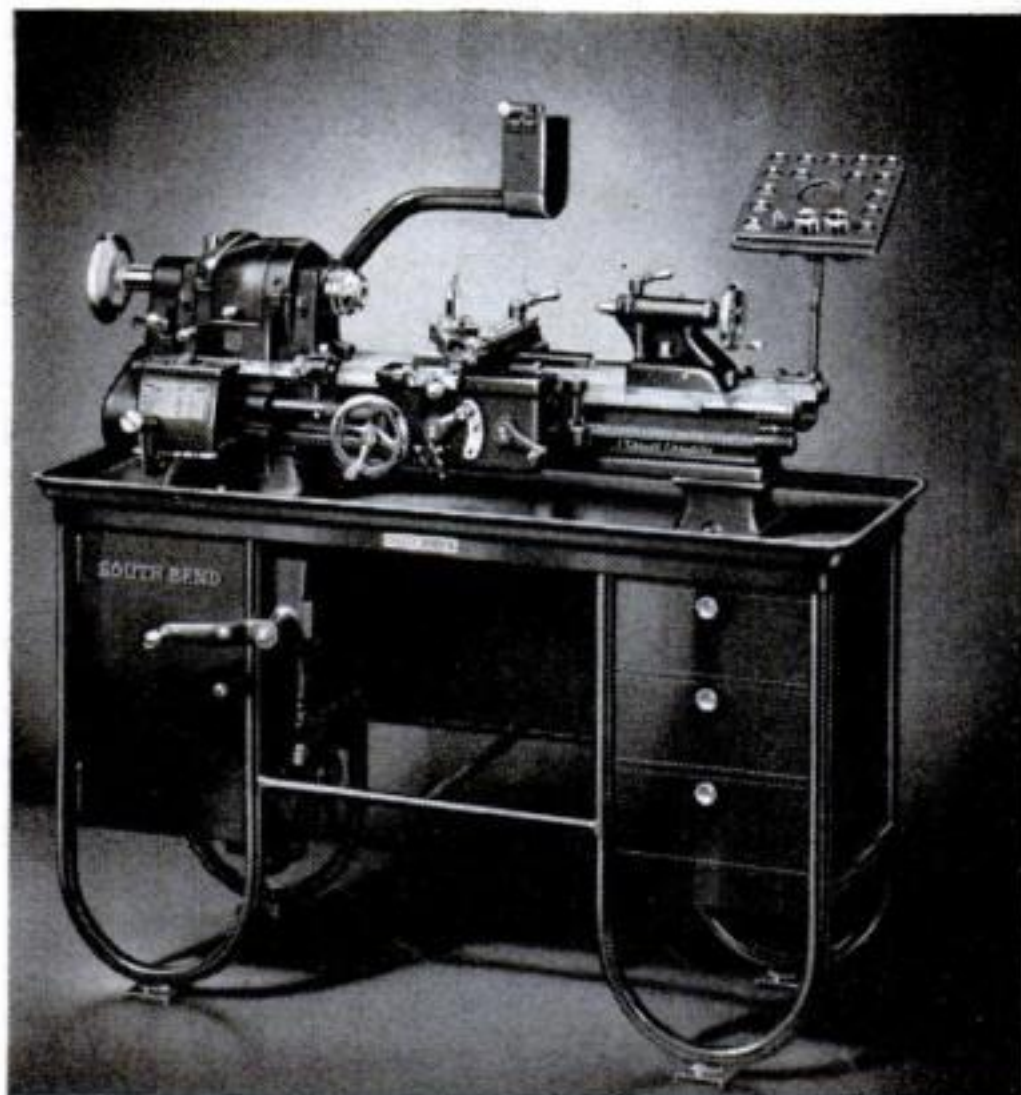
Swing	Bed Lengths	Center Distances
9"	3' to 4½'	16" to 34"
10"	3' to 4½'	15½" to 33½"
13"	4' to 7'	16" to 52"
14½"	5' to 10'	24½" to 84½"
16"	6' to 12'	33½" to 105½"

PARTIAL LIST OF DEALERS

See a South Bend Lathe before you buy. Write today for free catalog and name of nearest dealer.

Baltimore, Md.—Carey Mach. & Sup. New York, N. Y.—A. C. Colby Mach.
 Boston, Mass.—So. Bend Lathe Wks.* Philadelphia, Pa.—W. B. Rapp, Mach.
 Bridgeport, Conn.—A. C. Bisgood Pittsburgh, Pa.—Tranter Mfg. Co.
 Buffalo, N. Y.—R. C. Neal Co., Inc. Portland, Ore.—Portland Mach. Co.
 Chicago, Ill.—H. J. Volz Machinery Co. Providence, R.I.—G. T. Reynolds & Son
 Cleveland, Ohio—Reynolds Mach. Co. Rochester, N. Y.—Ogden R. Adams
 Dayton, O.—C. H. Gosiger Mach. Co. St. Paul—Robinson, Cary & Sands
 Detroit, Mich.—Lee Machinery Co. San Francisco, Cal.—Moore Mach.
 Los Angeles, Cal.—Eccles & Davies Seattle, Wash.—Star Machinery Co.
 Milwaukee, Wis.—W. A. Voell Mach. Syracuse, N. Y.—H. A. Smith, Mach.
 Newark, N. J.—J. R. Edwards Mach. York, Pa.—York Mach. & Supply Co.

*Boston Sales Office: 67 Broadway, Kendall Square, Cambridge, Mass.
 W. H. Peckard Manager Telephone Trowbridge 6369



SOUTH BEND LATHE WORKS

Lathe Builders Since 1906

827 E. Madison Street, South Bend, Indiana, U. S. A.



Help Uncle Sam's Defense Program!

4 million more skilled workers needed during next 12 months for America's thirty billion dollar defense program. Here's your chance to do vitally important work for your country, and at the same time boost your earnings. Start or extend your machine-shop education NOW with the New Encyclopedia of Machine Shop Practice—offered at an amazingly low price! See inside cover.

TURN YOUR MECHANICAL ABILITY INTO BIG MONEY! Get Started for a Big Pay Job in Machine-Shop Work! Machinists—Use this Refresher Course—learn the latest improvements in shop practice—Prepare for Promotion!

SEE INSIDE—THEN RUSH YOUR ORDER VIA AIR MAIL

BUSINESS REPLY CARD

No Postage Stamp Necessary if
Mailed in the United States

7c POSTAGE WILL BE PAID BY

WM. H. WISE & CO., Inc.

50 West 47th Street
NEW YORK, N. Y.

FIRST CLASS
PERMIT NO. 10
(Sec. 510, P.L.&R.)
NEW YORK, N. Y.

VIA
AIR MAIL

HAND THIS CARD TO A FRIEND

BUSINESS REPLY CARD

No Postage Stamp Necessary if
Mailed in the United States

7c POSTAGE WILL BE PAID BY

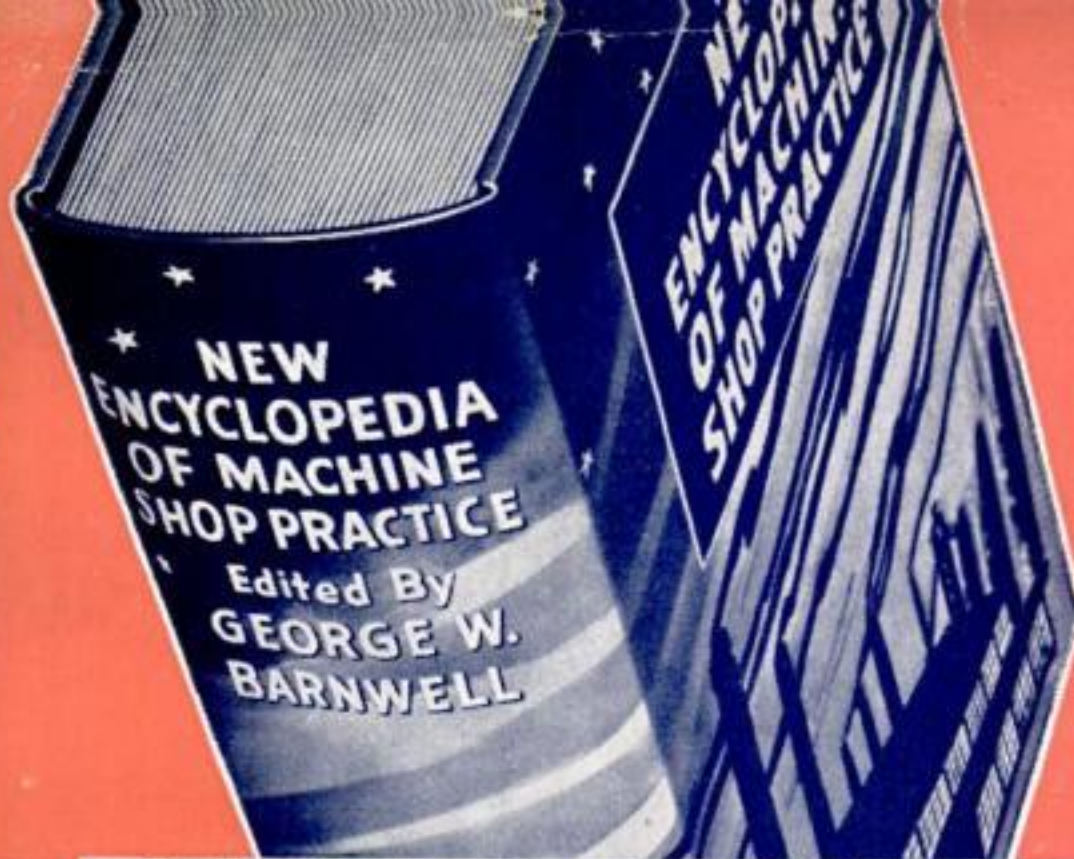
WM. H. WISE & CO., Inc.

50 West 47th Street
NEW YORK, N. Y.

FIRST CLASS
PERMIT NO. 10
(Sec. 510, P.L.&R.)
NEW YORK, N. Y.

VIA
AIR MAIL

THIS CARD FOR YOUR OWN



Urgent!

To insure getting a copy of this book, RUSH AIR MAIL POSTCARD at the bottom of this page. Hand the Courtesy Order Card to a friend.

COURTESY ORDER CARD

AIR MAIL—NO STAMP NEEDED

WM. H. WISE & CO., Inc., Dept. 8010A
50 West 47th Street, New York City

Please send me, for 5 days' free examination, a copy of the NEW ENCYCLOPEDIA OF MACHINE SHOP PRACTICE, 576 pages, nearly 1,000 illustrations, bound in semi-flexible Textileather. When the book arrives, I will deposit \$1.98, plus a few cents postage and handling charges with the postman. At the end of 5 days, I may return the book and you will refund my deposit. Otherwise, I will keep the book and the deposit will be considered payment in full.

Name _____

Address _____

City _____ State _____

☐ Check here if you prefer Thumb Notch Indexed Edition, in Dupont water-resistant binding, easily cleanable, for only 50 cents more. Same terms.

HAND THIS CARD TO A FRIEND

CUT OUT AND RUSH THIS AIR MAIL CARD

NO STAMP NEEDED

WM. H. WISE & CO., Inc., Dept. 8010
50 West 47th Street, New York City

Please send me, for 5 days' free examination, a copy of the NEW ENCYCLOPEDIA OF MACHINE SHOP PRACTICE, 576 pages, nearly 1,000 illustrations, bound in semi-flexible Textileather. When the book arrives, I will deposit \$1.98, plus a few cents postage and handling charges with the postman. At the end of 5 days, I may return the book and you will refund my deposit. Otherwise, I will keep the book and the deposit will be considered payment in full.

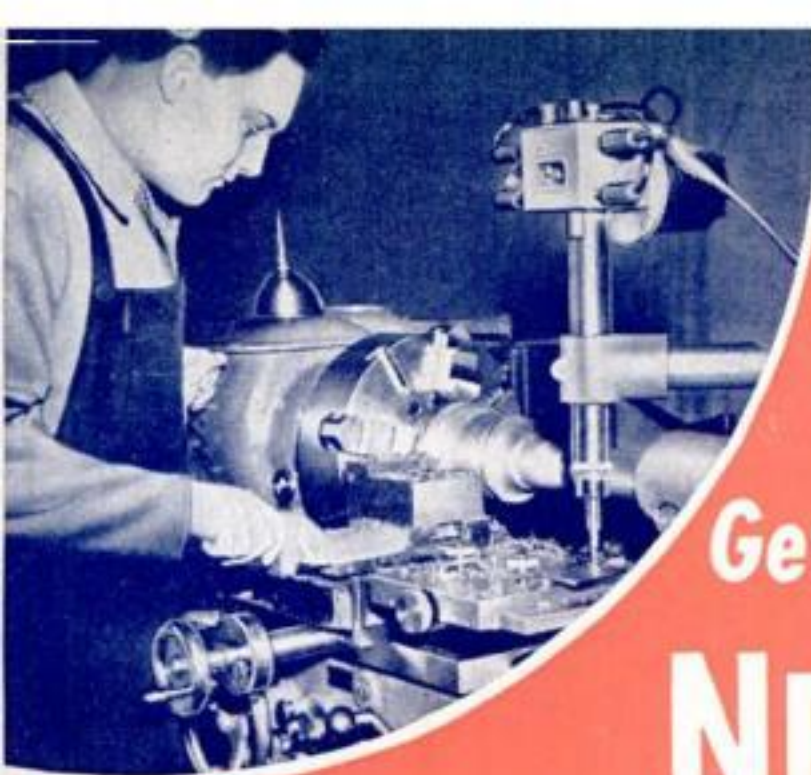
Name _____

Address _____

City _____ State _____

☐ Check here if you prefer Thumb Notch Indexed Edition, in Dupont water-resistant binding, easily cleanable, for only 50 cents more. Same terms.

THIS CARD FOR YOUR OWN USE



Thousands of Machinists Wanted

Get Started for a Big Pay Job With The

NEW ENCYCLOPEDIA OF MACHINE SHOP PRACTICE

...a reading course and reference book in one big volume...FOR ONE

To Every POPULAR SCIENCE Reader! Claim Your Copy WHILE SUPPLY LASTS. Rush Your Order on Attached AIR MAIL CARD at Our Expense!

AMERICA'S rapidly expanding industries are calling for machinists and more machinists! The demand is greater than the supply! Rates of pay were never higher! What an opportunity for men who like work that combines the skill of hands and brains! For such men anxious to get started in this profitable field, we have published the **NEW ENCYCLOPEDIA OF MACHINE SHOP PRACTICE** at the sensationally low introductory price of \$1.98. Our first announcement brought an overwhelming response from **POPULAR SCIENCE** readers. We were fortunate in

being able to pick up several carloads of paper at the old prices, so we rushed arrangements for a huge additional printing. But with costs soaring and materials getting scarcer, we cannot guarantee to supply this edition for very long. You are urged to **RUSH** your order on the postage-paid **AIR-MAIL POSTCARD** attached. Hand the **Courtesy Order Card** (also **AIR MAIL**) to any friend who may also want to order a copy.

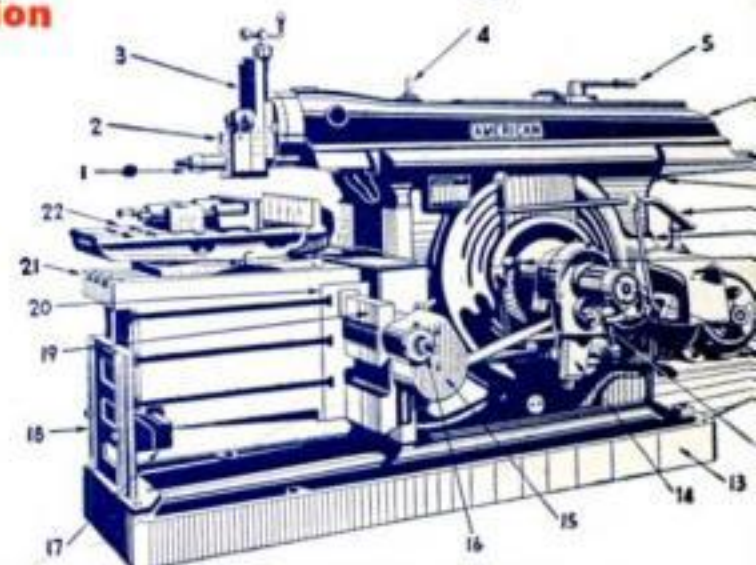
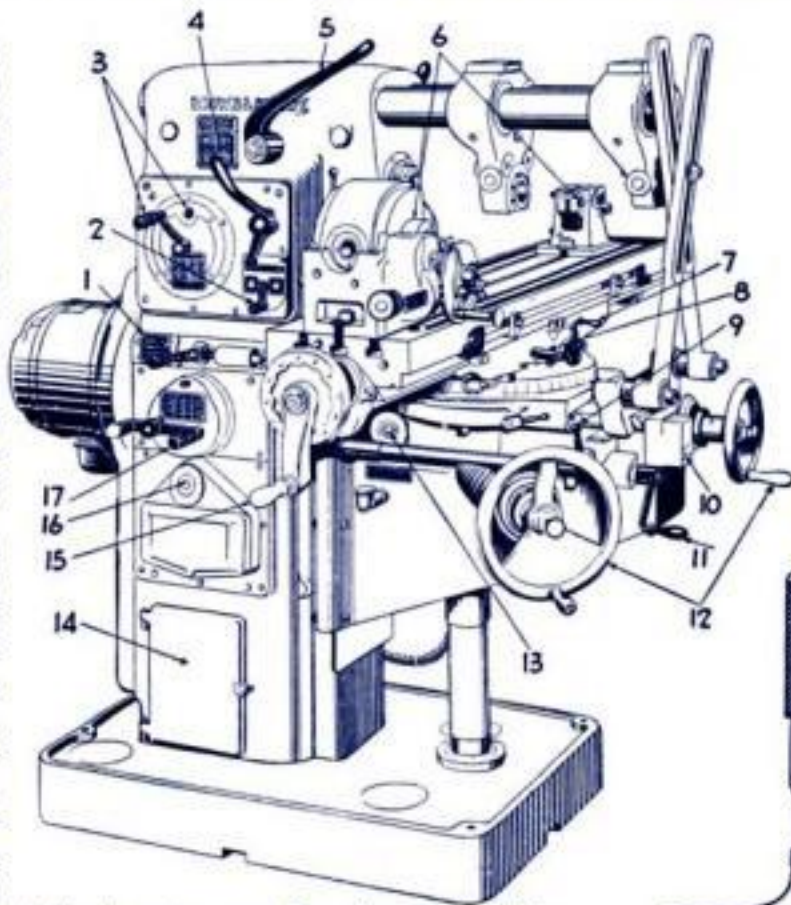
This amazing book shows you in almost 1,000 crystal-clear illustrations and easy to understand text exactly how every function of the machinist is performed! Written by practical experts in simple language so that even the beginner can make rapid progress; a ready reference work also for every machine operator, metal worker, draughtsman or mechanic.

Describes and Illustrates Every Basic Machine Shop Operation
Covers Every Problem that Confronts Even the Expert Machinist

COMPLETE chapters in this volume are devoted to every type of Bench Work; different types of metal used by the machinist; Turret and Automatic Lathes, and their innumerable functions, attachments and operations. There are chapters covering every type of Screw-Cutting; Taper-Turning; Knurling; Milling and Grinding.

Included in the broad scope of this volume is full information on Special Machine Tools and Machine Attachments; Jigs and Fixtures; Punch Press Operations. Instruction is given in Heat-Treating of Metals; Welding and Soldering; Drop-Forging; Foundry Work; Gauging and Testing. Complete descriptions and explanations of all types of Calipers, Micrometers and other precision measuring instruments used by machinists are included. There is also a special chapter on Reading Machine Blue Prints. And there are dozens of tables designed to save time for the machinist and to simplify mathematical calculations.

Copyright, 1941, by Wm. H. Wise & Co., Inc.

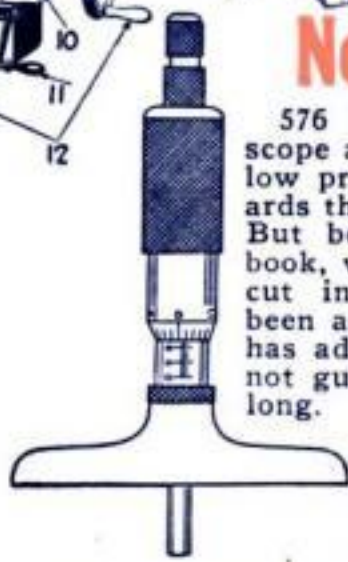
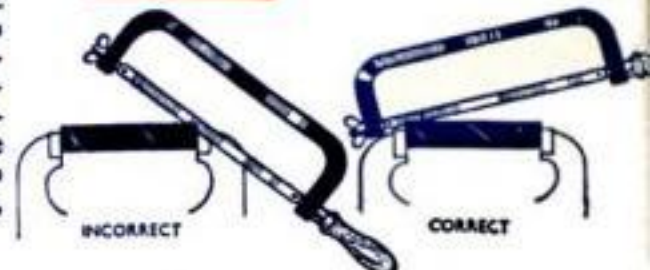


Nearly 1000 Pictures

576 Pages. Imagine a work of this scope and importance offered at the incredible low price of \$1.98! By ordinary price standards this volume should sell for around \$10. But because there is a great need for this book, we are experimenting with a drastically cut introductory price. However, we have been advised that the paper used in this book has advanced 42% in cost. Therefore we cannot guarantee the low price of \$1.98 for very long.

To avoid disappointment, **RUSH** your order now via the postage-paid **AIR-MAIL POSTCARD** attached. Hand the extra **AIR MAIL POSTCARD** to a friend! **Wm. H. Wise & Co., Dept. 8010, 50 West 47th St., N.Y.C.**

\$1.98
An Amazing Bargain!





ANGELA CUMMINS
Chesterfield's
Girl of the Month

At all the Games
It's CHESTERFIELD

For MILDNESS, for BETTER TASTE and COOLER SMOKING, Chesterfield is the winning cigarette... they're quick to satisfy with their *right combination* of the world's best cigarette tobaccos.

All around you, pack after pack, you'll see Chesterfields giving smokers a lot more pleasure. *Join in, light 'em up, and you've got a cigarette to cheer about.*

Everywhere you go...
it's have a Chesterfield *They Satisfy*